Water Hyacinth Control Program

ADDENDUM TO THE FINAL

Programmatic Environmental Impact Report

August 1, 2013

A program for effective control of Water Hyacinth in the Sacramento-San Joaquin Delta and its tributaries.

Copies of this Addendum to the Final Programmatic Environmental Impact Report in hard copy form, or as a PDF file, can be obtained from the Division of Boating and Waterways.

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Cover photo: March 14, 2008, by
NewPoint Group, Inc., of the
Wheeler Island Duck Club,
at Honker Bay.

DEPARTMENT OF PARKS AND RECREATION
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Major General Anthony L. Jackson, USMC (Ret.), *Director*

CERTIFICATION OF THE DEPUTY DIRECTOR OF THE CALIFORNIA DEPARTMENT OF PARKS AND RECREATION, DIVISION OF BOATING AND WATERWAYS

I, Sylvia O. Hunter, Deputy Director of the California Department of Parks and Recreation, Division of Boating and Waterways, approve this Addendum to the Water Hyacinth Control Program (WHCP) Programmatic Environmental Impact Report (PEIR), and hereby certify the following:

1. The Addendum to the WHCP PEIR has been completed in compliance with the California Environmental Quality Act.
2. The Addendum to the WHCP PEIR reflects the Division of Boating and Waterways' independent judgment and analysis.
3. I reviewed and considered the information in the Addendum to the WHCP PEIR, and approve of the Water Hyacinth Control Program as described in the Addendum.

______________________________ ______________________

Sylvia O. Hunter
Deputy Director
California Department of Parks and Recreation,
Division of Boating and Waterways

Date

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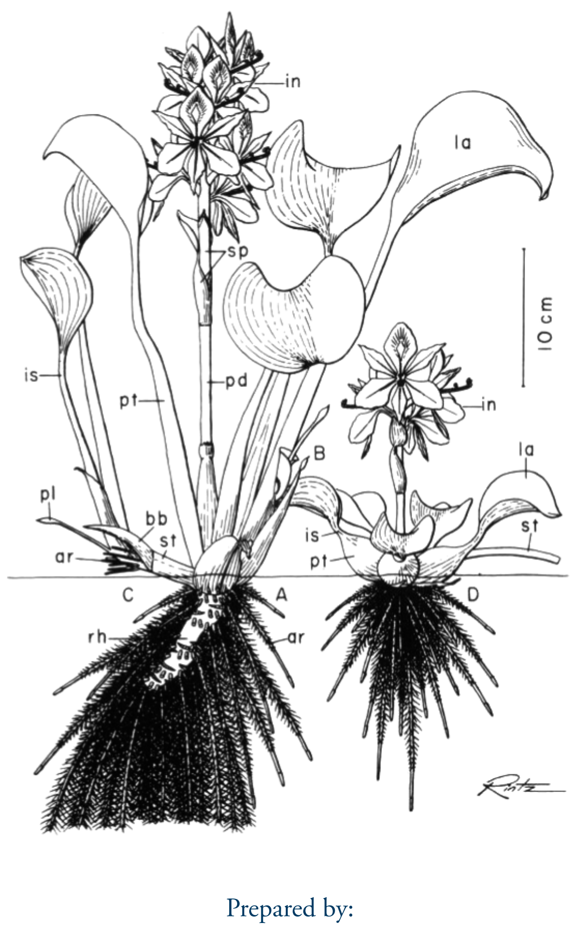

Prepared by:
The California Department of Parks and Recreation, Division of Boating and Waterways

With Technical Assistance from:
NewPoint Group, Inc.
www.newpointgroup.com

Water hyacinth *(Eichhornia crassipes)*

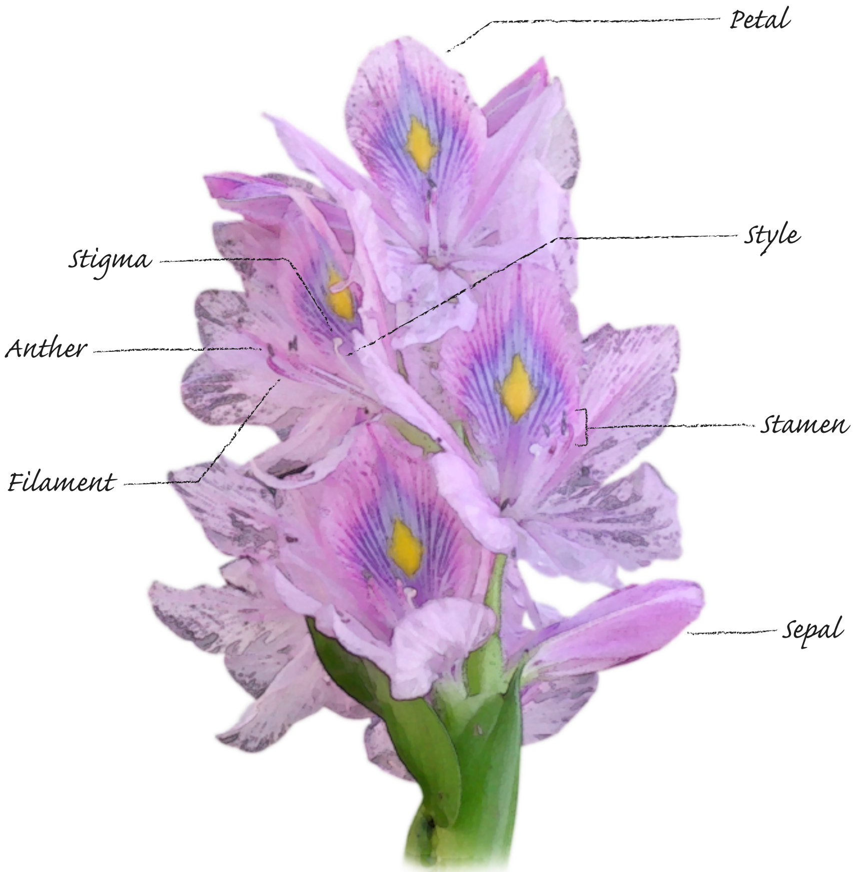

Table of Contents

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Acronyms and Abbreviations

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1. **2,4-D** – 2,4-Dichlorophenoxyacetic acid
2. **ALS** – acetolactate synthase
3. **BA** – Biological Assessment
4. **BO** – Biological Opinion
5. **CDFW** – California Department of Fish and Wildlife (formerly California Department of Fish and Game)
6. **CDPR** – California Department of Pesticide Regulation
7. **CEQA** – California Environmental Quality Act
8. **CFR** – Code of Federal Regulations
9. **CVRWQCB** – Central Valley Regional Water Quality Control Board
10. **DBW** – Department of Boating and Waterways (or Division of Boating and Waterways)
11. **DEC** – Department of Environmental Conservation (New York)
12. **DMA** – dimethlyamine
13. **DO** – Dissolved Oxygen
14. **DOE** – Department of Ecology (Washington)
15. **DWR** – Department of Water Resources
16. **EDCP** – *Egeria densa* Control Program
17. **EFED** – Environmental Fate and Effects Division
18. **EIR** – Environmental Impact Report
19. **IEP** – Interagency Ecology Program
20. **kg** – kilogram
21. **l** – liter
22. **LC50** – Lethal Concentration for 50% of Subjects
23. **LD50** – Lethal Dose for 50% of Subjects
24. **LGL** – Large Granular Lymphocyte
25. **LOC** – Letter of Concurrence
26. **mg** – milligram
27. **mph** – miles per hour
28. **MSDS** – Material Safety Data Sheet
29. **NMFS** – National Marine Fisheries Service
30. **NOAA** – National Oceanic and Atmospheric Administration
31. **NOEC/NOEL** – No Observable Effect Concentration or No Observable Effect Level
32. **NPDES** – National Pollutant Discharge Elimination System
33. **PEIR** – Programmatic Environmental Impact Report

34. **ppb** – parts per billion
35. **PPE** – Personal Protection Equipment
36. **ppm** – parts per million
37. **PRC** – Public Resources Code
38. **SWRCB** – State Water Resources Control Board
39. **TBD** – To Be Determined
40. **USBR** – United States Bureau of Reclamation
41. **USC** – United States Code
42. **USDA-ARS** – United States Department of Agriculture – Agricultural Research Service
43. **USEPA** – United States Environmental Protection Agency
44. **USFWS** – United States Fish and Wildlife Service
45. **WHCP** – Water Hyacinth Control Program

Chapter 1
Introduction and Overview

1. Introduction and Overview

As Lead Agency, the California Department of Boating and Waterways (DBW) prepared a programmatic environmental impact report (PEIR) for the Water Hyacinth Control Program (WHCP).[1] The PEIR was prepared in accordance with California Environmental Quality Act (CEQA) Guidelines. DBW certified the PEIR on December 8, 2009. The State Clearinghouse number for the WHCP PEIR is 2008052033.

The WHCP is an aquatic weed program designed to control the growth and spread of water hyacinth in the Sacramento-San Joaquin Delta (Delta) and its tributaries. In 1982, in response to concerns about water hyacinth in the Delta, the California Legislature passed Senate Bill 1344 (Garamendi, Chapter 263, Statutes of 1982), designating DBW as the lead agency for controlling water hyacinth in the Delta, its tributaries, and Suisun Marsh. The WHCP is a well-established program, which has been operating in the Delta for over twenty-eight (28) years.

DBW established an interagency Task Force in the first years of the WHCP to coordinate the control activities of federal, state, and local interests. The United States Department of Agriculture, Agricultural Research Service (USDA-ARS) was a member of this initial task force, and has provided technical and programmatic advice to the WHCP since the program's inception in 1983. USDA-ARS has served as the federal nexus for the WHCP for the last fifteen (15) years, providing research and scientific expertise.

As described in the PEIR, the WHCP utilizes treatment protocols that balance the need to control water hyacinth with the need to minimize resulting environmental impacts to Delta waterways. As described in the PEIR, the selected program alternative consists of an integrated aquatic weed management approach, emphasizing chemical treatment, with limited handpicking and herding, and continued assessment of biological controls.

Consistent with their adaptive management approach, DBW is implementing modifications to the WHCP that will improve effectiveness and/or reduce the potential for detrimental environmental impacts. These program changes are also incorporated into USDA-ARS and DBW's consultation process under Section 7 of the Endangered Species Act (50 CFR 402; 16U.S.C. 1536(c)). As such, these

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[1] As of July 1, 2013, the California Department of Boating and Waterways will merge with the California Department of Parks and Recreation, and become the Division of Boating and Waterways. The DBW acronym refers to either the Department or Division.

program changes are described and analyzed in the WHCP Biological Assessment (BA), dated October 25, 2012, the National Marine Fisheries Service (NMFS) Letter of Concurrence (LOC) dated February 27, 2013, and the United States Fish and Wildlife Service (USFWS) Biological Opinion (BO)dated March 13, 2013.

The purpose of this WHCP PEIR Addendum is to (1) describe program changes made since the WHCP PEIR was completed over three years ago, and (2) determine whether the proposed modified program would result in new, or substantially more severe, significant impacts compared with the impacts disclosed in the certified WHCP PEIR. This addendum is prepared in accordance with CEQA Guidelines Section 15164.

As described in this Addendum, DBW has determined that the program changes will not result in changes that would require the preparation of a subsequent or supplemental EIR. As a result, DBW has prepared only this WHCP PEIR Addendum to describe the WHCP program changes and their potential impacts.

This WHCP PEIR Addendum is organized as follows:

- Chapter 1 – Introduction and Overview: describes the purpose of the Addendum and related CEQA requirements
- Chapter 2 – WHCP Project Changes as Compared to PEIR Project Description: summarizes the six adaptive management changes implemented since the WHCP PEIR was prepared in 2009
- Chapter 3 – Effects Analysis: provides an impacts assessment of the six program changes as compared to the impacts analysis presented in the WHCP PEIR

Photo: Water hyacinth infestation in the Delta, 2012

- Chapter 4 – Conclusions: summarizes effects of the WHCP project changes
- References – identifies literature referenced in this addendum
- Appendix A – Fish Passage Protocol: presents the revised Fish Passage Protocol, developed in October 2012 for the WHCP BA.

This WHCP PEIR Addendum is meant to complement the November 30, 2009, Final WHCP PEIR, and the October 25, 2012, WHCP Biological Assessment. These two documents provide more detailed descriptions of WHCP operations and impacts that are not duplicated in this Addendum.

A. California Environmental Quality Act Requirements

This section provides the CEQA requirements as they relate to subsequent, supplemental, and addendums to previously completed Environmental Impact Reports (EIRs). Public Resources Code (PRC) Section 21166 limits the responsibility of an agency to prepare an additional EIR, once one has been certified for a project. Section 21166 provides as follows:

21166. Subsequent or Supplemental Impact Report; Conditions.

When an environmental impact report has been prepared for a project pursuant to this division, no subsequent or supplemental environmental report shall be required by the lead agency or by any responsible agency, unless one or more of the following events occurs:

a) Substantial changes are proposed in the project which will require major revisions of the environmental impact report.

b) Substantial changes occur with respect to the circumstances under which the project is being undertaken which will require major revisions in the environmental impact report.

c) New information, which was not known and could not have been known at the time the environmental impact report was certified as complete, becomes available.

The CEQA Guidelines further refine the circumstances under which a supplemental or subsequent EIR may be required. Guidelines Section 15162 and Section 15163 provide as follows:

15162. Subsequent EIRs and Negative Declarations

a) When an EIR has been certified or a negative declaration adopted for a project, no subsequent EIR shall be prepared for that project unless the lead agency determines, on the basis of substantial evidence in the light of the whole record, one or more of the following:

1) Substantial changes are proposed in the project which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;

2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR or Negative Declaration due to the involvement of new significant environmental effects of a substantial increase in the severity of previously identified significant effects; or

3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR was certified as complete or the Negative Declaration was adopted, shows any of the following:

A. The project will have one or more significant effects not discussed in the previous EIR or negative declaration;

B. Significant effects previously examined will be substantially more severe than shown in the previous EIR;

C. Mitigation measures or alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or

D. Mitigation measures or alternatives which are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

b) If changes to a project or its circumstances or new information becomes available after adoption of a *negative declaration, the lead agency shall prepare a subsequent EIR if required under subdivision (a). Otherwise the lead agency shall determine whether to prepare a subsequent negative declaration, an addendum, or no further documentation.*

c) Once a project has been approved, the lead agency's role in project approval is completed, unless further discretionary approval on that project is required. Information appearing after an approval does not require reopening of that approval. If after the project is approved, any of the conditions described in subdivision (a) occurs, a subsequent EIR or negative declaration shall only be prepared by the public agency which grants the next discretionary approval for the project, if any. In this situation no other responsible agency shall grant an approval for the project until the subsequent EIR has been certified or subsequent negative declaration adopted.

d) A subsequent EIR or subsequent negative declaration shall be given the same notice and public review as required under Section 15087 or Section 15072. A subsequent EIR or negative declaration shall state where the previous document is available and can be reviewed.

15163. Supplement to an EIR

a) The Lead or Responsible Agency may choose to prepare a supplement to an EIR rather than a subsequent EIR if:

1) Any of the conditions described in Section 15162 would require the preparation of a subsequent EIR, and

2) Only minor additions or changes would be necessary to make the previous EIR adequately apply to the project in the changed situation.

b) The supplement to the EIR need contain only the information necessary to make the previous EIR adequate for the project as revised.

c) A supplement to an EIR shall be given the same kind of notice and public review as is given to a draft EIR under Section 15087.

d) A supplement to an EIR may be circulated by itself without recirculating the previous draft or final EIR.

e) When the agency decides whether to approve the project, the decision-making body shall consider the previous EIR as revised by the supplemental EIR. A finding under Section 15091 shall be made for each significant effect shown in the previous EIR as revised.

* * * * *

The conditions which would require preparation of a subsequent or supplemental WHCP PEIR do not exist. The program changes are not substantial, do not involve significant new or increased environmental effects, and do not require major revisions of the environmental impact report. The program changes do not change the circumstances under which the project is being undertaken, do not involve significant new or increased environmental effects, and do not require major revisions of the environmental impact report. Finally, new information has not shown that the program changes result in new or more severe significant effects, or mitigation measures that DBW declines to adopt.

When there are program changes, but the conditions requiring a subsequent or supplemental EIR do not occur, the lead agency may prepare an addendum to an EIR. Section 15164 of the CEQA Guidelines provides the following, as related to addendums:

15164. Addendum to an EIR or Negative Declaration

a) The lead agency or responsible agency shall prepare an addendum to a previously certified EIR if some changes or additions are necessary but none of the conditions described in Section 15162 calling for preparation of a subsequent EIR have occurred.

b) An addendum to an adopted negative declaration may be prepared only if minor technical changes or additions are necessary or none of the conditions described in Section 15162 calling for the preparation of a subsequent EIR or negative declaration have occurred.

c) An addendum need not be circulated for public review but can be included in or attached to the final EIR or adopted negative declaration.

d) The decision making body shall consider the addendum with the final EIR or adopted negative declaration prior to making a decision on the project.

e) A brief explanation of the decision not to prepare a subsequent EIR pursuant to Section 15162 should be included in an addendum to an EIR, the lead agency's findings on the project, or elsewhere in the record. The explanation must be supported by substantial evidence.

This WHCP PEIR Addendum fulfills the requirements of Section 15164 of the CEQA Guidelines. This Addendum explains DBW's decision not to prepare a subsequent or supplemental PEIR, and provides substantial evidence (in Chapter 3) to support the decision.

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Chapter 2

WHCP Project Changes as Compared to PEIR Project Description

2. WHCP Project Changes As Compared to PEIR Project Description

The WHCP follows an adaptive aquatic weed integrated management approach. In 28 years of operating the WHCP, DBW has examined and tested a broad range of potential control methods. Reflecting this adaptive management approach, the WHCP has evolved during this time to continuously incorporate new information and experience. The selected WHCP alternative in the PEIR reflects DBW prior years of experience, and provides flexibility to continue to adapt the program over time. This flexibility extends to mitigation measures. As described in the PEIR, proposed mitigation measures may be revised and/or additional mitigation measures incorporated as a result of the ongoing consultation process with regulatory agencies.

Changes to the WHCP reflect program adaptations made since the PEIR was finalized in 2009. These minor program changes are intended to improve the effectiveness of the WHCP while reducing environmental effects, and/or without resulting in significant new effects. This chapter describes the program improvements implemented starting in 2013, and the reasoning that supports them. Chapter 3 discusses the likely effects of each program change. The WHCP Biological Assessment, dated October 25, 2012, provides a more detailed description of current WHCP activities and likely effects. The program changes cover six different areas:

1. Treatment start dates
2. Program herbicides
3. Mechanical harvesting
4. Valley elderberry avoidance
5. Fish passage protocol and dissolved oxygen mitigation measures
6. Water quality monitoring.

A. Treatment Start Dates

The National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) Biological Opinion (BO) that guided the WHCP between 2006 and 2010 specified avoidance measures in order to avoid periods when juvenile steelhead and salmon might be present. Mitigation measure #5 requires DBW to implement temporal and spatial limitations and restrictions on herbicide treatments to minimize treatments during times, and at locations, where larval and/or migratory fish are likely to be present. DBW will continue to implement this mitigation measure, with minor revisions.

USDA-ARS and DBW submitted a WHCP Biological Assessment to NMFS and the United States Fish and Wildlife Service (USFWS) on October 25, 2012, with revised avoidance measures. These revised measures still avoid some time periods when juvenile steelhead, salmon, and delta smelt might be present, but allow for earlier start dates. Earlier start dates increase the ability of DBW to treat water hyacinth mats when they are smaller and before they spread, ultimately reducing the amount of herbicide that must be applied. The new treatment start date approach is as follows (implementation may vary slightly):

1. The WHCP will begin regular field surveys in known nursery areas (focusing on back-water and dead end locations) in late-February of each season
2. When field surveys show contiguous areas of more than 100 square feet of re-growing water hyacinth (seen as re-greening of winter stunted plants), crews will photograph the sites and document the locations
3. DBW's environmental scientist will compare these surveyed locations to the most recent state and federal fish monitoring data
4. As often as weekly between March 1 and July 1, DBW's environmental scientist will prepare a summary list including:
    a. Site number(s) and map of potential early treatment sites
    b. Whether or not listed fish species are known to be present
5. DBW's environmental scientist will email this information to the primary technical contacts at USFWS and NMFS during the week prior to the proposed treatment week. The primary technical contacts at USFWS and NMFS may reply via email if they agree that the data show that listed fish are not likely to be present and that treatment may proceed. If USFWS or NMFS have questions or concerns about the potential treatment sites, they will contact DBW's environmental scientist by email and/or telephone to discuss treatment options at the site
6. The WHCP will continue conducting field surveys and reporting re-growing water hyacinth to USFWS and NMFS until July. Sites that show re-growth of over 100 square feet of water hyacinth will be evaluated for presence of listed fish, and immediately treated (with USFWS and NMFS approval)
7. The WHCP will not conduct treatments in the northern portion of the Delta (Area 1) until June 1 of each treatment season in order to avoid potential impacts to delta smelt. **Exhibit 2-1,** on the next two pages, illustrates the USFWS areas. Appendix B provides a list of WHCP treatment sites by USFWS area
8. If state and federal fish survey data shows that listed fish are not likely to be present at Delta sites, WHCP may begin chemical treatments in those sites
9. If state and federal fish survey data shows that fish are likely to be present at Delta sites, WHCP will not begin chemical treatments, but will continue to survey fish data to determine when listed fish are not present, and when treatments may begin. **Figure 2-1,** on page 2-5. summarizes treatment dates and locations.

Exhibit 2-1

Water Hyacinth Control Program Project Area - Northern Sites

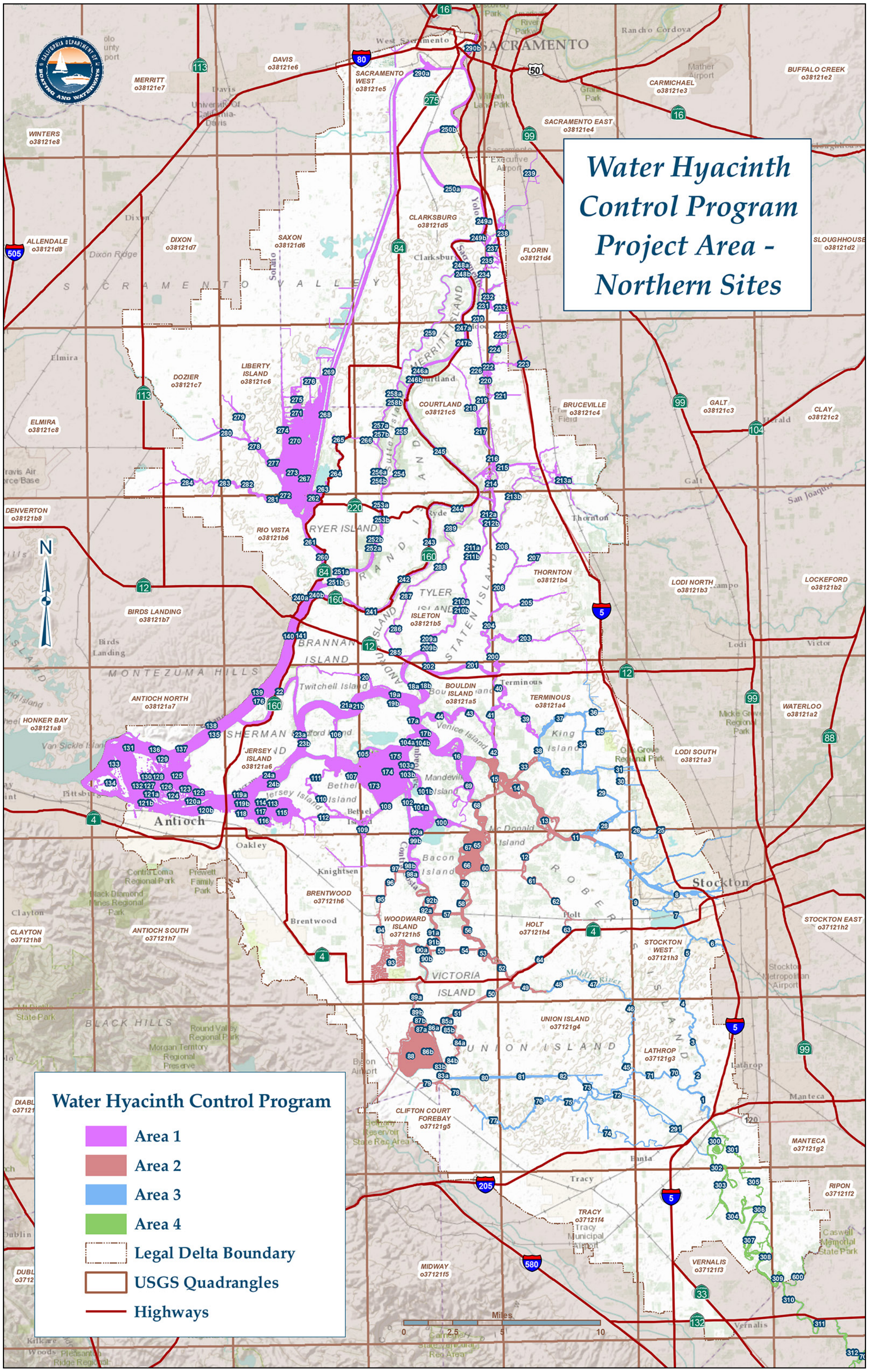

Exhibit 2-1 *(continued)*

Water Hyacinth Control Program Project Area - Southern Sites

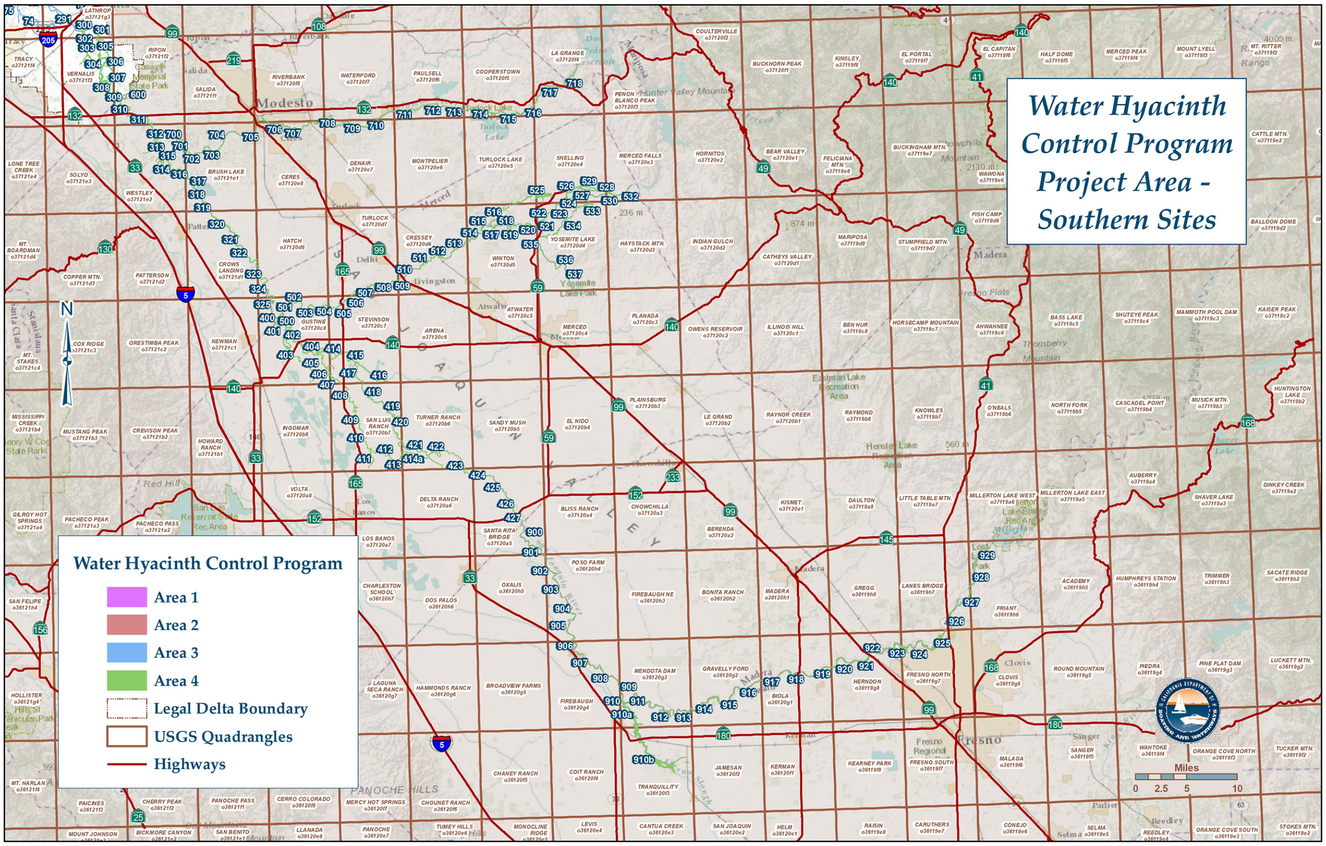

Figure 2-1

WHCP Treatment Sites[a], Herbicides, and Timing

Delta smelt (DS) Habitat Level	USFWS Area	Delta Boundary Area	Treatment Site Numbers	Fish Survey Reporting Required[b,c]	Glyphosate	2,4-D[d]	Penoxsulam[e]	Imazamox[e]	Agridex	Competitor
Primary DS Habitat	1	Legal Delta North of Hwy 12	200- 290	June 1 to June 30	June 1 to Nov. 30	No	No	No	June 1 to Nov. 30	No
		Legal Delta South of Hwy 12	16-24b, 39-44, 69, 98a-176	June 1 to June 30	June 1 to Nov. 30	June 15 to Sept. 15	No	No	June 1 to Nov. 30	No
Secondary DS Habitat	2	Legal Delta South of Hwy 12	11-15, 33, 49-68, 78, 79, 83a-97	March 1 to June 30	March 1 to Nov. 30	June 15 to Sept. 15	No	No	Mar. 1 to Nov. 30	No
Tertiary DS Habitat	3	Legal Delta South of Hwy 12	1-10, 25-38, 45-48, 70-77, 80-82, 291	March 1 to June 30	March 1 to Nov. 30	June 15 to Sept. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30
Non-DS Habitat	4	Legal Delta South of Hwy 12	300-309	March 1 to June 30	March 1 to Nov. 30	June 15 to Sept. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30
		Non-Legal Delta	310 and above	March 1 to June 30	March 1 to Nov. 30	July 15 to Aug. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30

[a] DBW may not treat in any site if DO is between 3 ppm and Basin Plan limits (5 ppm to 8 ppm, by location). DBW may not treat if winds are >10 mph (or >7 mph in Contra Costa County).

[b] DBW will implement a survey-based approach to conducting treatments that allows for treatments from March through June in areas with re-growing water hyacinth when listed fish species are not present, as reported to NMFS and USFWS.

[c] DBW environmental scientists will continue to monitor fish surveys and avoid treating in sites where listed fish species are present; however, formal weekly reporting to NMFS and USFWS is not required after July 1.

[d] The 2,4-D time and location restrictions are specified in the NMFS BO for the Environmental Protection Agency registration of pesticides in order to protect listed salmonid species.

[e] DBW will monitor the efficacy of the new herbicides penoxsulam and imazamox (time to symptoms, plant death, and regrowth).

The WHCP will regularly consult several state and federal fish surveys to monitor presence of listed fish species. During the treatment season, including the March to July time period when listed fish species may be present in the Delta, DBW environmental scientists will compare results from fish surveys with scheduled treatment sites to determine likely presence of listed fish species. These surveys include the following:

- USFWS "DatCall" data (juvenile fish monitoring program through the Interagency Ecology Program (IEP)). This survey includes three trawls and various beach seines at locations throughout the Delta. Reports are sent on a weekly basis to provide data from the previous week (http://www.fws.gov/stockton/jfmp)
- California Department of Fish and Wildlife (CDFW) surveys and studies (also through IEP). These surveys include the 20mm Survey, Smelt Larva Survey, and Spring Kodiak Survey in the Delta, Suisun Bay, and San Francisco Bay. Results are posted on the CDFW website within 72 hours of data collection on interactive maps (http://www.dfg.ca.gov/delta/data/)
- Department of Water Resources (DWR) and United States Bureau of Reclamation (USBR) (through CDFW)

fish salvage data. These daily and weekly reports provide salvage data collected at the state and federal fish salvage facilities (http://www.dfg.ca.gov/delta/apps/salvage/Default.aspx and http://www.water.ca.gov/swp/operationscontrol/calfed/calfedmonitoring.cfm)

- FishBio San Joaquin Basin Update reports on surveys in the San Joaquin Basin, including Calaveras River, Stanislaus River, Tuolumne River and Mokelumne River. Report frequencies vary, and will be used to supplement the regular surveys listed above. DBW also subscribes to the FISHBIO newsletter (http://fishbio.com/fisheries/industry-news/regional-fisheries-news)
- CDFW Knights Landing Rotary Screw Trap (RST) data provides weekly reports (via email newsletter) of fish presence on the Sacramento River at Knights Landing. This location is outside of the WHCP program area, but migration of fish at Knights Landing can indicate movement toward the Delta.

Photo: Mechanical removal with excavator.

Photo: Mechanical cutter and conveyor equipment.

B. Program Herbicides

The WHCP PEIR described the two herbicides that the DBW utilized for water hyacinth treatments at the time the PEIR was prepared, 2,4-D (2,4-Dichlorophenoxyacetic acid, dimethlyamine salt (DMA)) and glyphosate. Since 2009, the California Department of Pesticide Regulation (CDPR) has approved two new aquatic herbicides for treating water hyacinth: penoxsulam and imazamox. These new herbicides are reduced risk herbicides, meaning that they pose less risk to human health and the environment than conventional herbicides. **Exhibit 2-2,** on the following page, provides a comparison of the four WHCP herbicides.

There are several reasons why WHCP is adding new herbicides to the program. First, new lower-toxicity profile herbicides have the potential to reduce the environmental impact of the WHCP. Second, new herbicides may reduce the amount of herbicide applied to Delta waterways to treat water hyacinth. Third, timing and crop restrictions currently limit the application of 2,4-D, which has been the primary and most effective WHCP herbicide. Thus, expanding the number of herbicides beyond 2,4-D and glyphosate

Exhibit 2-2
Summary Comparison of WHCP Treatment Herbicides

	2,4-D	Glyphosate	Penoxsulam	Imazamox
Status	CDPR approved In use	CDPR approved In use	CDPR approved New	CDPR approved New
Application Rate	64 to 128 ounces/acre 4.58 lb. a.i./acre	96 ounces/acre 4.05 lb. a.i./acre	2 to 5.6 ounces/acre 0.03125 to 0.0875 lb. a.i./acre	16 to 64 ounces/acre 0.1325 to 0.53 lb. a.i./acre
Calculated Concentration in 1 Meter Deep Water with 20% Overspray (at Maximum Application Rate)	103 ppb	91 ppb	2 ppb	11.9 ppb
NPDES Maximum Limitation in Receiving Waters	70 ppb	700 ppb	10.1 ppm	To Be Determined
USEPA Fish Toxicity Classification	Practically non-toxic	Slightly toxic to practically non-toxic	Practically non-toxic	Practically non-toxic
Pros	Proven effective; lower cost; selective broadleaf herbicide	Proven effective	Requires less herbicide; lower toxicity; good WH control in studies; less DO impact; low cost per acre	Requires less herbicide; lower toxicity; good WH control in studies; less DO impact; relatively fast acting (same browning time as glyphosate); quick drying; no irrigation restrictions
Cons	Limited application period; can't be used near grapes, tomatoes; higher concentrations required than new herbicides	Slower acting than 2,4-D; binds to sediment; slow drying; higher concentrations required than new herbicides; non-selective; increased cases of terrestrial weed resistance	Potential for groundwater pollution, although low potential at application rates; 1ppb irrigation water restriction	No NPDES receiving water maximum limitation yet determined due to recent CDPR approval

expands treatment options. Fourth, utilizing herbicides with varying modes of action reduces the potential for target species to develop resistance. While there are no indications of water hyacinth resistance to date, some terrestrial species of weeds have developed resistance to glyphosate and acetolactate synthase (ALS) inhibitors, and the aquatic weed hydrilla may develop resistance to fluridone.

Addition of penoxsulam and imazamox to the WHCP reflect the program's adaptive management philosophy. The WHCP will continue to evaluate, and may incorporate, new aquatic herbicides as they become available.

USDA-ARS and DBW will contract with the California Department of Fish and Wildlife (CDFW) to conduct toxicity testing of imazamox, penoxsulam, and the new adjuvant Competitor on delta smelt adults, larvae, and eggs. Until these tests are complete (and show no toxic effects at WHCP levels), WHCP will utilize the new chemicals only in USFWS Areas 3 and 4 (see Exhibit 2-1).

C. Mechanical Harvesting

The WHCP PEIR analyzed mechanical harvesting as one of the program alternatives to the selected integrated program alternative. At the time that the WHCP PEIR was prepared, there were concerns about the cost of mechanical harvesting, and the potential release of plant fragments that could regrow into new water hyacinth mats. However, current mechanical removal equipment reduces the potential for plant fragments to lead to increased infestations. The WHCP will now utilize two different mechanical removal approaches. Both of these methods will be used in relatively limited situations, and will supplement the primary chemical treatment approach.

The first mechanical harvesting approach will be to park a small excavator and dump truck on a concrete boat ramp and mechanically scoop water hyacinth from the waterway surrounding the ramp. Crews will support the excavation by herding water hyacinth that is outside of the excavator's reach closer to the equipment. This mechanical removal approach will be used only in limited locations when water hyacinth growth is concentrated near a boat ramp. There may be relatively few locations within the Delta that are appropriate for excavation.

The second approach will utilize mechanical equipment designed specifically to safely remove aquatic weeds from waterways. This mechanical equipment utilizes cutters and conveyors to physically remove the plant from the water and onto the bed of the equipment. The equipment collects and unloads vegetation using a conveyor system on a boom, adjustable to the appropriate cutting height (two to three feet below the surface for water hyacinth). Cutter bars collect material and bring it aboard the vessel using the conveyor. When the vessel has reached capacity (between 2,000 and 15,000 pounds of plant material), the cut plant material will be offloaded to a dump truck parked at a nearby boat ramp to offload water hyacinth. Water hyacinth will be disposed of at an authorized location, typically utilizing nearby farm fields.

Mechanical removal can be costly, it will be used to supplement chemical treatment and when immediate removal of weeds is required. Mechanical removal will primarily be utilized to remove dense mats of water hyacinth in locations where chemical treatment must be avoided, such as sites with many valley elderberry shrubs along the shoreline.

WHCP environmental scientists will consult several state and federal fish surveys to monitor presence of listed fish species when using mechanical removal. In addition, WHCP environmental scientists will survey mechanical removal sites immediately prior to weed removal to help ensure that no listed species are present. If listed species are present, mechanical removal operations at that site will be postponed. Similar mechanical equipment is regularly used to control water hyacinth in Florida and other Southeastern states.

The WHCP will implement an operation protocol similar to the protocol for chemical treatment prior to conducting mechanical removal. WHCP environmental scientists will check state and federal fish survey data to ensure that listed species are not present at the removal site. In addition, the equipment operator will utilize the same Environmental Checklist to evaluate presence of listed species or sensitive habitats. If listed species or sensitive habitats are present, the operator will not conduct mechanical removal at that site.

Source: www.fws.gov.

Photo: valley elderberry longhorn beetle.

D. Valley Elderberry Avoidance

The WHCP PEIR includes a mitigation measure to provide a 250 foot buffer between treatment sites and shoreline elderberry shrubs, host plant for the threatened valley elderberry longhorn beetle *(Desmocerus californicus dimorphus).* DBW implemented this avoidance measure for many years, and found that the 250 foot buffer was extremely conservative when combined with DBW operational practices to reduce herbicide drift. As a result, there were some treatment sites with a large number of shoreline valley elderberry at which water hyacinth could not be treated. The inability to treat at these sites led to significant growth of water hyacinth mats, resulting in negative impacts on navigation, recreation, public safety, and the environment. In consultation with USFWS, DBW reduced the buffer distance. The lower buffer still provides protection to valley elderberry shrubs located adjacent to WHCP treatment sites.

For most treatment sites, DBW will maintain a 100 foot buffer between treatment sites and shoreline elderberry shrubs, and will conduct treatments downwind of elderberry shrubs. In addition, WHCP treatment protocol requires that DBW treat only when winds are less than 10 mph (or 7 mph in Contra Costa County), and to utilize a coarse droplet size to avoid potential for drift.

Currently numbered treatment sites with relatively large numbers of valley elderberry shrubs include: 10, 11, 46, 47, 48, 99, 234, 511, 529, 707, 708, and 710. At some of these (or other) sites, the 100 foot buffer requirement may still preclude DBW's ability to treat water hyacinth. In those cases, DBW will utilize a smaller, 50 foot buffer between treatment sites and valley elderberry shrubs. However, when utilizing the smaller buffer, DBW will only treat when winds are less than 3 mph. This will further minimize potential for drift.

The mitigation measure related to valley elderberry avoidance now reads as follows:

> Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs *(Sambucus ssp.)*, host plant for the valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)*. When there are a large number of valley elderberry shrubs that may preclude treatments at the 100 foot buffer, DBW may provide a 50 foot buffer between treatment sites and shoreline elderberry shrubs if treatments occur when winds are less than 3 mph.

E. Fish Passage Protocol and Dissolved Oxygen Mitigation Measures

In March 2001, the State Water Resources Control Board (SWRCB) issued the DBW a National Pollutant Discharge Elimination System (NPDES) permit for the WHCP. One of the conditions of WHCP's 2001 NPDES permit required the DBW to develop a protocol to be followed to ensure that the WHCP operations provide a zone of passage to fish at all times. The original WHCP Fish Passage Protocol was developed in 2001 and implemented by the WHCP through the 2012 treatment season. This protocol was incorporated into the 2009 WHCP Programmatic Environmental Impact Report (PEIR), and has been a component of WHCP operations since 2001.

Conditions and requirements have changed since the 2001 Fish Passage Protocol was developed. In March 2006, the CVRWQB issued a NPDES General Permit for Aquatic Weed Control, replacing the prior NPDES permit. The WHCP has been following the NPDES General Permit requirements since 2006. Currently, the State Water Resources Control Board is in the process of revising the NPDES General Permit for Aquatic Weed Control, with implementation expected in December 2013. The 2006 or 2013 NPDES permits do not require a fish passage protocol.

Since 2001, the DBW has also received biological opinions for the program. Conditions in the biological opinions by USFWS and NMFS promote fish passage in Delta waters. WHCP environmental monitoring since 2001 has not found negative impacts to fish, or low dissolved oxygen levels that might impede fish passage. The WHCP has dropped one herbicide (diquat) and added new herbicides (penoxsulam and imazamox). Furthermore, herbicide labels for the two original WHCP herbicides (2,4-D and glyphosate) are now less restrictive than they were in 2001 in regards to measures to avoid dissolved oxygen impacts.

As a result of these significant changes, DBW and United States Department of

Agriculture, Agricultural Research Service (USDA-ARS) have revised the fish passage protocol. A formal fish passage protocol is not required by the NPDES permit. However, DBW and USDA-ARS will implement this new fish passage protocol as a condition to reduce the potential for negative effects on listed fish species movement near water hyacinth treatment sites.

The revised fish passage protocol is included in **Appendix A** of this addendum. The new fish passage protocol complies with herbicide label requirements to reduce potential for low dissolved oxygen. The protocol is based on combined recommendations of an aquatic weed expert, an herbicide company representative, the Pacific Northwest Weed Management Handbook, Washington State NPDES requirements, herbicide label requirements, Delta water conditions, prior dissolved oxygen monitoring data, the prior 3 acre limit, and literature on salmon migration. The intent is to provide a fish passage protocol with quantitative treatment limits that provide conservative fish protection, reflect actual Delta conditions, take into account the variability in treatment site size (6.5 acres to 1,707 acres) and consider field constraints.

The WHCP PEIR describes mitigation measures that were also included in the 2001 Fish Passage Protocol to reduce the potential for reductions in dissolved oxygen. A reduction in dissolved oxygen is determined to be an avoidable significant impact reduced to a less-than-significant level in the PEIR. The four PEIR mitigation measures are as follows:

1. Monitor dissolved oxygen levels pre- and post-treatment for all WHCP treatments.
2. Treat no more than three (3) contiguous acres at any treatment site.
3. Treat no more than one-half of the area at one time of completely infested dead-end sloughs to allow for fish passage.
4. Treat no more than one-half of completely infested moving waterways at one time to allow for fish passage.

The DBW is revising the mitigation measures, as follows, to reflect the new fish passage protocol:

1. <u>Monitor dissolved oxygen levels pre- and post-treatment for all WHCP treatments</u>. NO CHANGE
2. <u>Treat in up to three (3) acre strips, leaving at least 100 foot buffer strips between treated areas</u>. Treat water hyacinth mats that are larger than 3 acres in size following the fish passage protocol.
3. <u>Treat no more than thirty (30) percent of completely infested dead-end sloughs to allow for fish passage</u>. In slow-moving and back-end sloughs infested with water hyacinth, treat up to 30 percent of the water hyacinth mat at one time. Mats will be treated in up to 3 acre strips, leaving at least 100 foot buffer strips between treated areas. The untreated buffer strips and remaining 70 percent of the water hyacinth mat will be treated at least three more times following the initial treatment (in 30 percent increments). These follow-up treatments will take place at three week intervals.
4. <u>Treat no more than one-half of completely infested moving waterways at one time to allow for fish passage</u>. In tidal waters, treat up to 50 percent of the water hyacinth mat at one time. Mats will be treated in up to 3 acre strips,

leaving at least 100 foot buffer strips between treated areas. The untreated buffer strips and remaining 50 percent of the mat will be treated three weeks following the initial treatment for 2,4-D treatments, and one week following initial treatment for other herbicides.

F. Water Quality Monitoring

The WHCP follows NPDES general permit requirements for residual aquatic pesticide discharges. The SWRCB has revised the prior permit (Order No. 2004-0009-DWQ). The new permit will go into effect on December 1, 2013. As specified in the WHCP PEIR, DBW will follow NPDES monitoring requirements. DBW will continue to follow NPDES monitoring requirements; however, the requirements will change from those described in the WHCP PEIR. During 2013, the monitoring provisions specified in 2004-0009-DWQ will remain in effect. The monitoring provisions will change once the revised permit goes into effect.

The new general permit (2013-0002-DWQ) changes the monitoring frequency. The current requirement specifies that permitees monitor at ten (10) percent of all application sites for each herbicide and each water type (flowing and non-flowing water). The new permit changes the sampling frequency to a minimum of six (6) application events for each active ingredient in each environmental setting (flowing water and non-flowing water) per year, except for glyphosate. If the results from six consecutive application events show concentrations that are less than the receiving water limitation/trigger for an active ingredient, sampling shall be reduced to one (1) application event per year for that active ingredient in that environmental setting. For glyphosate, DBW will be required to collect one (1) sample from each environmental setting. DBW will continue to follow NPDES general permit requirements for residual aquatic pesticide discharges, if and when, they are revised.

The new NPDES permit sampling requirements are materially less than what has been historically measured, in terms of frequency of measurement. To help ensure that the WHCP maintains environmental quality measures and that monitoring provides independent statistical validity, DBW will maintain a more robust monitoring plan than the minimal NPDES requirements.

Chapter 3

Effects Analysis

3. Effects Analysis

This chapter assesses the effects of the WHCP program changes as compared to the effects described in the WHCP PEIR. For each program change, this section identifies and analyzes only relevant new environmental impacts potentially resulting from the new program operation, as compared to the impacts in the PEIR. The discussion of impacts utilizes findings from the WHCP PEIR, the October 25, 2012 WHCP Biological Assessment, technical information from scientific literature, and program experience. This section discusses potential impacts of WHCP changes in four areas: biological resources, hydrology and water quality, hazards and hazardous materials, and cumulative effects.

A. Impacts Assessment of Treatment Start Dates

The treatment start dates specified in the WHCP PEIR are incorporated into mitigation measure #5 (B2a). Mitigation measure #5 is intended to reduce the potential for unavoidable or potentially unavoidable significant impacts related to acute or sublethal toxic impacts from WHCP herbicides or adjuvants to special status fish, amphibians, reptiles, or birds, or to reduce the potential that WHCP herbicides would result in toxic effects that would impact native resident or migratory fish species. The WHCP PEIR concludes that it is extremely unlikely that there would be acute toxic impacts, and that the potential for sublethal impacts is low. However, the PEIR concludes that should sublethal toxic impacts result, they could constitute an unavoidable or potentially unavoidable significant impact that would potentially be reduced by mitigation measures, including mitigation measure #5.

Biological Resources

Mitigation measure #5 specifies that the WHCP will: implement temporal and spatial limitations and restrictions on herbicide treatments to minimize treatments during times, and at locations, where larval and/or migratory fish are likely to be present. The revised treatment start date approach changes only the details of this mitigation measure, not the intent and result. As described in Chapter 2, DBW follows a specific process, in coordination with USFWS and NMFS, to identify potential early treatment sites and to help ensure that listed fish species are not likely to be present. Thus, the new approach to treatment start dates will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts. The early start date could ultimately lower the potential for significant impacts by reducing the amount of herbicide that must be used to treat water hyacinth.

B. Impacts Assessment of New Program Herbicides

The WHCP PEIR includes extensive analyses of the potential effects of 2,4-D and glyphosate on biological resources, hydrology and water quality, and a hazards and hazardous materials impacts assessment. The discussion of biological resources in the PEIR includes potential effects on: special status fish, amphibians, reptiles, birds, invertebrates, resident native or migratory fish, sensitive habitat, and wetlands. The WHCP PEIR identifies unavoidable or potentially unavoidable significant impacts to biological resources related to herbicide overspray, herbicide toxicity, and food web effects. The WHCP PEIR identifies unavoidable or potentially unavoidable significant impacts to water quality related to herbicide treatments, plant fragments, and avoidable significant impacts due to boat operations. The hazards and hazardous materials impacts assessment in the PEIR includes potential effects of WHCP herbicides on the public and treatment crews. The WHCP PEIR identifies avoidable significant impacts related to treatment crew exposure and accidental spills, and less than significant impacts related to general public exposure to program herbicides.

Biological Resources

The WHCP BA includes detailed analyses of 2,4-D, glyphosate, penoxsulam, and imazamox on biological resources. These analyses demonstrate that the new WHCP herbicides, penoxsulam and imazamox, have reduced toxicity to fish, invertebrates, reptiles, birds, and food web effects as compared to 2,4-D and glyphosate. In terms of biological resources, the addition of penoxsulam and imazamox to the WHCP will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts. In fact, use of these new herbicides could lower the potential for toxic effects, and reduce the amount of herbicide needed to treat water hyacinth.

Hydrology and Water Quality

The WHCP PEIR identifies the unavoidable or potentially unavoidable significant impacts to hydrology and water quality as unlikely. The addition of penoxsulam and imazamox to the WHCP does not increase the severity or potential for significant impacts to hydrology and water quality. Because of their low toxicity to aquatic species and the absence of water quality criteria, there are no Maximum Contaminant Levels (MCLs) for penoxsulam and imazamox. The new General NPDES permit requires receiving water monitoring for penoxsulam and imazamox, but does not have a receiving water monitoring trigger.

There are no restrictions on consumption of penoxsulam treated water for potable use or by livestock, pets, or other animals, and no restrictions on the use of treated water for recreational use, including swimming and fishing. Similarly, for imazamox there are no restrictions on livestock watering, swimming, fishing, domestic use, or use of treated water for agricultural sprays. Penoxsulam and imazamox are less likely to result in decreases in dissolved oxygen to below water quality standards than 2,4-D or glyphosate. Similar to biological resources, the addition of penoxsulam and imazamox to the WHCP will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts. In fact, use of these new herbicides could lower the potential for negative effects to water quality by reducing the amount of herbicide needed to treat water hyacinth.

Hazards and Hazardous Materials

The addition of penoxsulam and imazamox to the WHCP will not result in new significant effects or an increase in the avoidable significant impacts that could result from treatment crew exposure or accidental spills to WHCP herbicides. As described below, penoxsulam and imazamox have low potential for acute, subchronic, or chronic toxicity to humans.

Exposure of the General Public and Treatment Crews to Penoxsulam and Imazamox

The potential for general public and treatment crew exposure to penoxsulam and imazamox is similar to the exposure potential to 2,4-D and glyphosate described in the PEIR. Potential exposure of the general public to WHCP herbicides through drinking water contamination or water recreation is unlikely. The potential for the WHCP to create a significant hazard to treatment crews through the routine transport, use, or disposal of WHCP herbicides is also low.

Pesticide workers, such as WHCP treatment crews, are exposed to higher levels of herbicides, and over longer time horizons, than the general public (Burns 2005). Some WHCP crew members have been with the program for over fifteen years. Each year, treatments take place as many as four days a week, over a six month period. This small group of individuals is uniquely exposed to WHCP herbicides over relatively long periods of time.

WHCP treatment crews follow herbicide label requirements for personal protective equipment (PPE). This includes use of coveralls, chemical resistant gloves, safety goggles, and waterproof shoes. DBW uses a laundry service to clean coveralls after a single day use. Liquid herbicides are drawn through feeder tube. The herbicide is then combined with Delta water (at the spray nozzle) prior to being applied onto the aquatic weed so that direct contact with the chemicals is not required. Granular or pellet formulations are placed into hoppers. Potential exposure routes include dermal exposure when rinsing or loading hoppers, or in the event that a feeder tube is broken. More likely exposure may occur through inhalation and dermal exposure from drift in the event that the wind shifts during treatment. None of these exposure routes is likely, although they may occur. Any potential exposure to WHCP herbicides would likely be at low levels and short-term. Below, we discuss the potential human health effects of penoxsulam and imazamox. These effects have not been discussed in prior WHCP reports.

Human Health Effects of Penoxsulam

United States Environmental Protection Agency (USEPA) and California Department of Pesticide Regulation (CDPR) evaluations of the human health effects of penoxsulam have found no adverse effects in acute, subchronic, and chronic studies. CDPR's summary of toxicology data for penoxsulam found "no data gap, no adverse effects" for chronic toxicity in rats and dogs, oncogenicity in mice, reproduction in rats, teratology in rats and rabbits, gene mutation, chromosome effects, DNA damage, and neurotoxicity (CPDR 2005). There were possible adverse effects in one oncogenicity study in rats (CDPR 2005).

When animal toxicity studies found effects from penoxsulam, they occurred at doses that were orders of magnitude higher than potential WHCP exposures. Potential WHCP exposures for penoxsulam are low. For example, the calculated concentration of penoxsulam out of the herbicide spray nozzle is 105 ppm, and the calculated concentration of penoxsulam if sprayed directly into the water (as opposed to onto the water hyacinth mat) is 9.8 ppb (USDA-ARS 2012). Chronic toxicity studies in rats, mice, and dogs, summarized below, found No Observable Effects Levels (NOEL) of 450 ppm to 900 ppm, or at oral doses of between 25 mg/kg/day to 2,000 mg/kg/day (CDPR 2005). USEPA calculated an oral reference dose (the maximum acceptable oral dose of a toxic substance) of 0.147 mg/kg/day for penoxsulam based on a NOEL of 14.7 mg/kg/day in a one-year dog feeding study and an uncertainty factor of 100. By comparison, drinking water with 150 ppb would contribute approximately 0.004 and 0.015 mg/kg/day for adults and children respectively (Washington DOE 2012). The 150 ppb penoxsulam concentration is 15 times higher than the concentration if penoxsulam was sprayed directly into the water instead of onto water hyacinth, a highly unlikely scenario.

Below, we briefly summarize representative mammal toxicity studies for penoxsulam:

- An acute oral toxicity study of penoxsulam in rats did not result in deaths at a dose of 5,000 mg/kg body weight (USEPA 2004a)
- An acute inhalation study in rats found an LC50 of greater than 3.5 mg/l, the highest attainable concentration, concluding that a single inhalation of mist from liquid formulations is not likely to cause adverse effects (Washington DOE 2012)
- Acute and chronic neurotoxicity studies found no effects doses of up to 2,000 mg/kg and 250 mg/kg/day, respectively (New York DEC 2008), and the USEPA Hazard Identification Assessment Review Committee concluded that there was no concern for neurotoxicity resulting from exposure to penoxsulam (Washington DOE 2012)
- A 28-day dermal toxicity study in rats found no dermal or systemic toxicity (USEPA 2004b)
- Short-term dermal toxicity studies did not identify a toxicity endpoint, and penoxsulam was not very acutely toxic or irritating to skin and eyes (New York DEC 2008). The Material Safety Data Sheet (MSDS) states that penoxsulam may cause slight but temporary irritation to eyes and slight irritation to skin (SePRO 2009)
- A chronic toxicity/oncogenicity study in rats found possible adverse effects in male rats. There were elevated large

granular lymphocyte (LGL) leukemia incidence in all treatment groups. However, distribution of severity was not affected in treated males, and there was a lack of dose-response over a 50-fold treatment range (CDPR 2005). Because of the weak findings, USEPA classified penoxsulam as “suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential” (Washington DOE 2012)

- A chronic toxicity study in dogs found a NOEL of 450 ppm (CDPR 2005)
- Chronic and oncogenicity studies in mice found no oncogenic effects. NOEL values were 10 mg/kg/day in males and 100 mg/kg/day in females. There were signs of toxicity to the liver and bladder at high penoxsulam levels
- Reproduction and teratology studies in rats, and teratology studies in rabbits, found no reproductive effects and NOELs of 30 to 300 mg/kg/day for offspring and parents. The development toxicity study in rabbits found a NOEL of 25 mg/kg/day (CDPR 2005)
- Subchronic feeding studies in mice and dogs found NOELs of 450 to 900 ppm in dogs and 10 mg/kg/day in mice. There were histopathological effects to dogs at high doses (4,500 ppm and above). In mice, liver weights were greater in mice exposed to 500 and 1,000 mg/kg/day.

These studies demonstrate that penoxsulam does not result in acute or chronic toxicity in mammals at very high doses. Some minor effects were seen, but not at doses, and levels, to raise concern. The treatment doses in these studies were orders of magnitude higher and required many more days of exposure than what could occur with possible accidental one-time exposure, or chronic exposure, of treatment crews to penoxsulam. The addition of penoxsulam as a WHCP herbicide will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts related to hazards and hazardous materials impacts.

Human Health Effects of Imazamox

USEPA and CDPR evaluations of the human health effects of imazamox have found no adverse effects in acute, subchronic, and chronic studies. CDPR’s Summary of Toxicology Data (2000) for imazamox found “no data gap, no adverse effects” for chronic toxicity in rats and dogs, oncogenicity in rats and mice, reproduction in rats, teratology in rats and rabbits, and no gene mutation, chromosome effects, DNA damage, or neurotoxicity.

Toxicity studies, utilizing high levels of imazamox exposure, found little or no signs of toxic effects at doses that were orders of magnitude higher than potential WHCP exposures. Potential WHCP exposures to imazamox are low. For example, the calculated concentration of imazamox directly out of the herbicide spray nozzle is 635 ppm, and the calculated concentration of imazamox if sprayed directly into the water (as opposed to onto the water hyacinth mat) is 59 ppb (USDA-ARS 2012). Chronic toxicity studies in rats, mice, dogs, and rabbits, summarized below, found NOELs of 7,000 ppm to 40,000 ppm, or from 300 mg/kg/day to approximately 1,200 mg/kg/day.

In animal studies using oral and dermal exposure routes, USEPA chronic and subchronic toxicity studies found no hazard at the highest dose required in toxicity studies (SERA 2010). USEPA originally calculated an oral reference dose of 3.0 mg/kg/day based on a NOEL of 300 mg/kg/day from a development toxicity study in rabbits and an uncertainty factor of 100 (Washington DOE 2012). USEPA later increased the oral reference dose to 9.0 mg/kg/day because the original study was based on weight reduction, which was not determined to be an adequate biological response. The higher oral reference dose is based on a NOEL of 900 mg/kg/day in rabbits (Washington DOE 2012). By comparison, a 150 pound person would need to drink 1 liter of the imazamox coming directly from the spray nozzle to be exposed to 9 mg/kg/day. The maximum potential exposure calculated for an aquatic applicator wearing contaminated gloves for one hour is approximately 0.8 mg/kg/day (SERA 2010). Calculated margins of safety (the ratio of the NOEL to the estimated exposure level) for potential imazamox exposures were extremely high – ranging from 150 to 450,000, resulting in a rating of low hazard for imazamox (Thurston County 2011).

Below, we briefly summarize representative mammal toxicity studies for imazamox:

- An acute toxicity study found no mortality and no clinical signs of toxicity in male and female rats that received a single oral dose of 5,000 mg/kg formulation (SERA 2010)
- An acute toxicity study of an imazamox soil metabolite found an LD50 of 2,274 mg/kg in rats, although many of the toxic effects may have been due to large amounts of the test substance in the GI tract (SERA 2010)
- Inhalation and dermal studies found that imazamox is relatively non-toxic by inhalation, slightly toxic by the dermal route, non-to-slightly irritating to skin, and slightly-to-moderately irritating to eyes (USEPA 1997). Imazamox is not a dermal sensitizer, based on assays using guinea pigs (SERA 2010)
- Acute, subchronic, developmental, reproduction, and chronic studies for the pesticide registration process found no evidence of neurotoxic effects (SERA 2010)
- A chronic oncogenicity study in mice found no carcinogenic effects or other findings of toxicological significance with dietary administration of up to 1,348 mg/kg/day (7,000 ppm) (CDPR 2000)
- A two generation reproduction study in rats found no adverse effects, with the exception of a reduction in weight gain without any dose response relationship for parental systemic, reproductive, and developmental factors. NOELs were 20,000 ppm in all three categories (CDPR 2000)
- Teratology studies in rats and rabbits found no adverse effects, with maternal NOELs of 300 mg/kg/day to 500 mg/kg/day based on reductions in weight gain, and developmental NOELs of 900 mg/kg/day to >1,000 mg/kg/day (CPDR 2000). [Note that this reduction in weight gain was not considered by USEPA to be a biologically significant endpoint]
- Subchronic toxicity studies with between 28 and 90 days exposure in dogs and rats found no adverse effects and NOELs of between 1,000 mg/kg/day and 1,550 mg/kg/day (equal to 20,000 ppm to 40,000 ppm) (CDPR 2000).

These studies demonstrate that imazamox does not result in acute or chronic toxicity in mammals at very high doses. The treatment doses in these studies were orders of magnitude higher, and required many more days of exposure, than what could occur with possible accidental exposure, or chronic exposure, of treatment crews to imazamox. The addition of imazamox as a WHCP herbicide will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts related to hazards and hazardous materials impacts.

C. Impacts Assessment of Mechanical Harvesting

The WHCP PEIR includes a brief analysis of mechanical harvesting. The WHCP BA includes an assessment of the potential effects of the two new mechanical harvesting approaches and describes mitigation measures.

Biological Resources

In prior analyses of the effects of mechanical harvesting, USFWS and NMFS concluded that mechanical harvesting was not likely to adversely affect listed species as long as efforts were made to minimize the impacts on listed species and harvesting occurred when listed species were not likely to be present. Current WHCP mechanical removal activities will have less potential of impacting listed species because the water hyacinth will be directly removed from the water. Removing plants will reduce the potential for lower dissolved oxygen due to plant decomposition and for plant fragments to spread.

Hydrology and Water Quality

There is a potential that mechanical harvesting could result in avoidable significant effects to water quality due to the increase in floating material that could cause nuisance or adversely affect beneficial uses. However, both types of mechanical harvesting operations collect any plant fragments that may be released during the harvesting process by following the existing mitigation measure to collect plant fragments during and immediately following treatment. Mechanical harvesting operations will also not change the potential impact of the WHCP on turbidity, which is expected to be less than significant. As compared to the range of potential program effects described in the PEIR, the inclusion of mechanical harvesting in the WHCP will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts.

D. Impacts Assessment of Valley Elderberry Avoidance

Biological Resources

The valley elderberry avoidance mitigation measure included in the WHCP PEIR addresses the potential for herbicide overspray to effect special status species, riparian or other sensitive habitats, and wetlands. Because the WHCP utilizes herbicides, there is the potential for overspray or drift to affect nearby plant species, including valley elderberry, host plant for the threatened valley elderberry longhorn beetle *(desmocerus californicus dimorphus).* The WHCP PEIR defines the potential for effects from herbicide overspray or drift as an unavoidable or potentially unavoidable significant impact.

Mitigation measure #2 (B1b) is being changed to provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs, rather than a 250 foot buffer. In some cases the buffer may be further reduced to 50 feet, with an additional condition to treat only when winds are less than 3 mph. WHCP experience over the last 28 years validates that given the operational practices that reduce potential for herbicide overspray or drift, reduction in the buffer size for valley elderberry shrubs is extremely unlikely to result in harmful effects to valley elderberry plants. This revised mitigation measure will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts.

E. Impacts Assessment of Revised Fish Passage Protocol and Dissolved Oxygen Mitigation Measures

Biological Resources

The dissolved oxygen mitigation measures included in the WHCP PEIR address the potential impact of herbicide treatments on local DO levels and resulting potential for impacts on special status species, resident native or migratory fish, sensitive habitat, and wetlands. The PEIR concludes that reductions in dissolved oxygen would represent avoidable significant impacts that would be reduced to a less-than-significant level through implementation of mitigation measures. The WHCP PEIR also addresses the potential impact of reduced dissolved oxygen following herbicide applications on water quality.

The program changes to the WHCP described in this addendum include minor changes to three of the four mitigation measures related to DO. The program changes also include a revised fish passage protocol; the prior mitigation measures were identified in the prior fish passage protocol. Under the revised fish passage protocol and revised mitigation measures, DBW will continue to monitor pre-treatment and post-treatment DO levels at all treatment sites, and will monitor dissolved oxygen for all water quality monitoring. The DBW and USDA-ARS will also conduct additional DO monitoring to evaluate the ongoing impacts of water hyacinth and water hyacinth treatments on DO.

As specified in the WHCP PEIR and WHCP BA, DBW follows all herbicide label guidelines as they relate to reducing the potential for negative effects to fish and water quality from increased dissolved oxygen. **Table 3-1,** on the next page, summarizes relevant herbicide label requirements related to DO.

The revised fish passage protocol specifies treatment approaches for tidal waters and dead-end sloughs that follow herbicide label specifications, allow for fish movement, and minimize the potential for increased dissolved oxygen following WHCP treatments. The WHCP BA concludes that WHCP operations will not result in reduced dissolved oxygen that could harm listed fish species or impair water quality, and that removal of water hyacinth will lead to increased dissolved oxygen in formerly infested areas. The revised fish passage protocol and DO mitigation measures will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts.

Table 3-1
Summary of Herbicide Label Requirements Related to Dissolved Oxygen and Repeat Treatments

Herbicide	Dissolved Oxygen Requirements	Number of Treatments	Time Between Treatments
2,4-D	It may be appropriate to treat only part of the infestation at one time. For example, apply the product in lanes separated by untreated strips that can be treated after the vegetation in treated lanes has disintegrated (2-3 weeks in growing season). Begin treatment along the shore and move outward in bands to allow fish to move into untreated areas.	Two applications per season	21 days between applications
Glyphosate	When infestations require treatment of the total surface area of impounded water*, treating the area in strips may avoid oxygen depletion due to decaying vegetation.	May require retreatment	24 hours between applications
Penoxsulam	None	Not specified	Not specified
Imazamox	None	Up to 4 applications per season at 32 ounces per acre application rate	Not specified

* The WHCP project area encompasses tidal and riverine waters, not impounded waters.

F. Impacts Assessment of Water Quality Monitoring

Hydrology and Water Quality

The DBW continues to follow State Water Resources Control Board NDPES general permit requirements for residual aquatic pesticide discharges. A new general permit becomes effective on December 1, 2013 (2013-0002-DWQ), and the details of the general permit water quality monitoring program will change, as compared to the details described in the WHCP PEIR. These changes relate to the frequency of water quality monitoring events and will not result in new significant environmental effects or a substantial increase in the severity of the already identified unavoidable or potentially unavoidable impacts. To help ensure that the WHCP maintains environmental quality measures and that monitoring provides independent statistical validity, DBW will maintain a more robust monitoring plan than the minimal NPDES requirements.

G. Assessment of Cumulative Impacts

The WHCP PEIR includes an assessment of the cumulative impacts of the WHCP in combination with the impacts of other projects in the Delta. Most Delta-wide projects are of far greater scope than the WHCP. None of the prior Delta EIRs or Environmental Impact Statements (EISs) reviewed for the PEIR (with the exception of the DBW's *Egeria densa* Control Program (EDCP) EIR) even considered the WHCP or EDCP in their cumulative impacts assessment. This suggests to the DBW that as compared to other Delta projects, the environmental impacts of the WHCP are immaterial.

The WHCP PEIR describes 33 past, present, and possible future projects (not including the WHCP) with which the WHCP may potentially contribute to cumulative impacts. The two environmental impact areas that the WHCP PEIR identified as most likely to be affected by cumulative impacts of the WHCP, combined with these other Delta projects and programs, were biological resources and hydrology and water quality. The WHCP PEIR determined that to the extent that any of these Delta projects create stress (of any kind) on special status species and habitats, this stress could be compounded by the combined impacts of each program. The WHCP implements mitigation measures to minimize WHCP impacts to biological resources. In addition, as these other projects and programs are implemented, they will also implement mitigation measures to minimize impacts on biological resources.

The potential for cumulative impacts to hydrology and water quality are similar to those of biological resources. The WHCP will potentially result in unavoidable, potentially unavoidable, or avoidable impacts to water quality. Several of these other Delta programs may also result in at least temporary impacts to water quality, that when combined with WHCP impacts, would be cumulatively considerable. WHCP mitigation measures minimize the WHCP's contribution to water quality degradation in the Delta. These other Delta projects will also implement mitigation measures to minimize impacts to hydrology and water quality.

The changes to the WHCP described in this Addendum will not increase the potential for cumulative impacts to biological resources or hydrology and water quality, or other resource areas. To the extent that the program changes reduce environmental impacts, they could reduce the potential for cumulative impacts.

Chapter 4

Conclusions

4. Conclusions

Consistent with an adaptive management approach, the WHCP is instituting program changes, as described in this addendum. These program changes are intended to improve the effectiveness, and/or reduce the effects of, the WHCP. DBW prepared this WHCP PEIR Addendum, in accordance with CEQA Guidelines Section 15164, to summarize the program changes and their potential impacts. Based on this assessment, DBW determined that a subsequent or supplemental environmental impact report is not required. As specified in Section 15162 and 15163 of the CEQA Guidelines, a supplemental or subsequent EIR is required when:

- *Substantial changes are proposed in the project which will require major revisions of the environmental impact report due to the involvement of new significant environment effects or a substantial increase in the severity of previously identified significant effects*
    - The program changes are not substantial, do not involve significant new or increased environmental effects, and do not require major revisions of the programmatic environmental impact report
- *Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions in the environmental impact report due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects*
    - The program changes do not change the circumstances under which the project is being undertaken, do not involve significant new or increased environmental effects, and do not require major revisions of the environmental impact report
- *New information, which was not known and could not have been known at the time the environmental impact report was certified as complete, becomes available and shows any of the following:*
    - *Result in one or more significant effects not discussed in the previous EIR*
    - *Result in substantially more severe significant effects than shown in the previous EIR*
    - *Result in new mitigation measures that DBW declines to adopt*
        - New information has not shown that the program changes result in new or more severe significant effects, or mitigation measures that DBW declines to adopt.

An agency may prepare a supplement to an EIR when one or more of the conditions in Section 15162 exist, but only minor changes to the original EIR would be required. As none of the conditions in Section 15162 exist for the WHCP program changes, DBW did not prepare a supplemental EIR.

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Appendix A

Fish Passage Protocol

Water Hyacinth Control Program
Fish Passage Protocol

October 17, 2012

Background

Water hyacinth (Eichhornia crassipes) is a non-native, free-floating aquatic macrophyte. Water hyacinth was first reported in California in 1904, and by the early 1980s this invasive weed had become a significant problem for agriculture, boating and recreation, and wildlife in the Sacramento-San Joaquin Delta (Delta) and its tributaries. Water hyacinth is characterized by showy lavender flowers and thick, highly glossy leaves up to ten inches across. The plant grows from 1 ½ to 5 feet in height, and the floating portion of the plant can grow to more than four feet in diameter. In the Delta, the plant is found in sloughs, connecting waterways, and tributary rivers. The growing season for water hyacinth in the Delta is typically from March to early December. Water hyacinth spreads and grows rapidly under favorable temperature and nutrient conditions such as those found in the Delta in the summer months, and mats may double in surface area in six to fifteen days.

SB 1344 (Garamendi, Chapter 263, Statutes of 1982) amended the California Harbors and Navigation Code to designate the California Department of Boating and Waterways (DBW) as the lead agency for controlling water hyacinth in the Delta, its tributaries, and the Suisun Marsh. DBW developed an interagency task force to coordinate the control activities of federal, state, and local interests and to resolve problems and concerns associated with public health and safety, and environmental impacts. DBW initiated the water hyacinth control program (WHCP) in 1983. The WHCP's primary treatment method has been chemical, supported by hand-picking, herding, and biological controls.

Current program herbicides include 2,4-Dichlorophenoxyacetic acid, dimethlyamine salt (2,4-D), glyphosate, penoxsulam, and imazamox. Imazapyr may be added to the program once the California Department of Pesticide Regulation (CDPR) approves its use for water hyacinth. Chemical treatment is typically conducted with hand-held sprayers from aluminum air or outboard motor boats. The boats are equipped for direct metering of herbicides, adjuvants, and water into pump delivery systems. Trained field crews spray the chemical mixture directly onto the plants. For the seventeen years between 1983 and 2011, the DBW treated between 160 and 2,770 acres of water hyacinth a year (out of 67,779 water acres in the project area). The WHCP is intended to support beneficial uses under the Clean Water Act, and there have been no known measurable water quality or environmental degradation effects, including no known impacts to fish.

The DBW and cooperating counties halted the WHCP in 2000 after a legal action from the *Delta Keepers* claimed that the DBW must obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Central Valley Regional Water Quality Control Board (CVRWQCB) under the 9th Circuit Court's Headwaters Inc. v. Talent Irrigation District decision. The DBW applied for the newly required NPDES permit in January 2000, and the

CVRWQCB developed permit conditions in October 2000, but did not issue a permit. In March 2001, the State Water Board issued the DBW a NPDES permit for the WHCP, incorporating most of the conditions developed by the CVRWQCB. One of the conditions of WHCP's NPDES permit required the DBW to develop a protocol to be followed to ensure that the WHCP operations provide a zone of passage to fish at all times. The original WHCP Fish Passage Protocol was developed in 2001 and implemented by the WHCP ever since. This protocol was incorporated into the 2009 WHCP Programmatic Environmental Impact Report (PEIR), and has been a component of WHCP operations since 2001.

Conditions and requirements have changed since the 2001 Fish Passage Protocol was developed. In March 2006, the CVRWQCB issued a NPDES General Permit for Aquatic Weed Control, replacing the prior NPDES permit. The WHCP has been following the NPDES General Permit requirements since 2006. Currently, the State Water Resources Control Board (SWRCB) is in the process of revising the NPDES General Permit for Aquatic Weed Control, with a final version expected in November 2012. The 2006 or 2012 NPDES permits do not require a fish passage protocol.

Since 2001, the DBW has also received biological opinions for the program. Conditions in the biological opinions by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) promote fish passage in Delta waters. WHCP environmental monitoring since 2001 has not found negative impacts to fish, or low dissolved oxygen levels that might impede fish passage. The WHCP has stopped using one herbicide (diquat), and is adding more reduced risk new herbicides (penoxsulam, imazamox, and in the future imazapyr), as evidence of their adaptive management program approach. Furthermore, herbicide labels for the two original WHCP herbicides (2,4-D and glyphosate) are now less restrictive in regards to measures to avoid dissolved oxygen impacts.

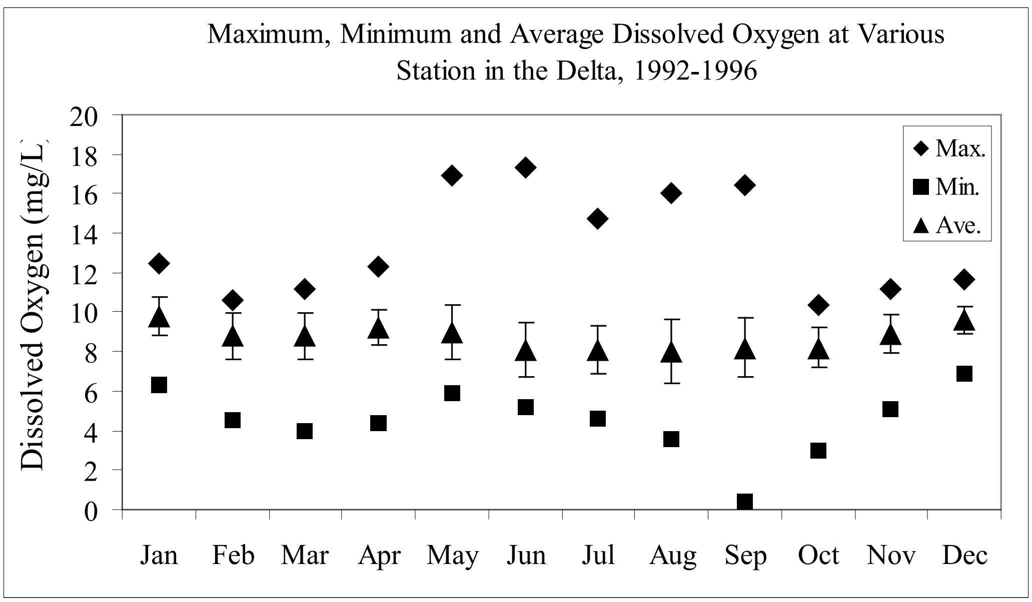
As a result of these significant changes, DBW and United States Department of Agriculture, Agricultural Research Service (USDA-ARS) have revised the fish passage protocol. A formal fish passage protocol is not required by the NPDES permit. However, DBW and USDA-ARS will implement this new fish passage protocol as a best practice to reduce the potential for negative effects on listed fish species movement near water hyacinth treatment sites.

Dissolved Oxygen and Water Hyacinth

Dissolved oxygen (DO) is the content of oxygen found in water. DO is determined by temperature, weather, water flow, nutrient levels, algae, and aquatic plants. Generally, a higher level of DO is beneficial to fish. Fish begin to experience oxygen stress or exhibit avoidance at levels below 5 mg/liter. Salmonids have been reported to actively avoid areas with low dissolved oxygen concentrations (Davis 1975 in Carter 2005). Fish will migrate to areas with higher DO levels. A 1990 study found that brookling trout moved away from water with DO concentrations of 1 to 1.9 mg/liter within one hour, moved away from water with DO concentrations of 2 to 2.9 mg/liter within one to two hours, and moved away more slowly from water with concentrations of 3 to 3.9 mg/liter (Carter 2005). Juvenile Chinook salmon avoided DO concentrations of 1.5, 3.0, and 4.5 mg/liter (Carter 2005). Salmonids are also likely to avoid water hyacinth mats in slow-moving waters and shorelines. In a fish migration study in Washington State, juvenile coho salmon, steelhead, and cutthroat trout were all found to use the faster-moving and deeper water sections of the waterway (Zydlewski et al. 2002).

DO levels drop in warmer temperatures, and increase with precipitation, wind, and water flow. Running water, such as the tidal water in the Delta, dissolves more oxygen than still water. Diurnal tidal movement also mixes lower DO water that might be present under a growing or decaying water hyacinth mat with incoming, higher DO, water. High levels of nutrients in water reduce DO levels, while algae and aquatic plants can increase DO through photosynthesis, but decrease DO through respiration and decomposition. DO levels fluctuate throughout the day, and are typically lowest in the morning and peak in the afternoon. In deep, still waters, DO levels are lower in the hypolimnion (bottom layer of water) because there is little opportunity for oxygen replenishment from the atmosphere. As illustrated in **Exhibit 1**, DO levels measured at various locations in the Delta averaged between 8 and 9.8 mg/l.

Exhibit 1.



Treatment of aquatic weeds with certain herbicides can result in a faster than natural decaying of plant biomass that may create a large biological oxygen demand, resulting in decreases in dissolved oxygen. DBW recognizes that decaying water hyacinth has the potential to temporarily reduce DO levels. The problem of low DO following herbicide treatment of water hyacinth is a concern when the herbicide is relatively fast-acting, such as 2,4-D, imazapyr, and to a lesser extent glyphosate. The labels for these three herbicides include recommendations to reduce the potential for DO impacts. The low DO following herbicide treatment may be amplified by the fact that DO levels under large water hyacinth mats can already be low. DBW conducts DO monitoring, as described in this document, to evaluate DO impacts following treatment. A further uncertainty as to the extent of potential low DO impacts on fish is that few native fish are found in water hyacinth mats (Hanni 2005).

Table 1, below, summarizes the herbicide label requirements regarding dissolved oxygen effects and timing of follow-up treatments, should they be required. Note that the follow-up treatment timing refers to treating previously treated plants a second (or more) time, not treating previously untreated plants in the same site. These requirements help to avoid negative impacts to fish resulting from decaying weeds.

Table 1
Summary of Herbicide Label Requirements Related to Dissolved Oxygen and Repeat Treatments (Current as of October 2012)

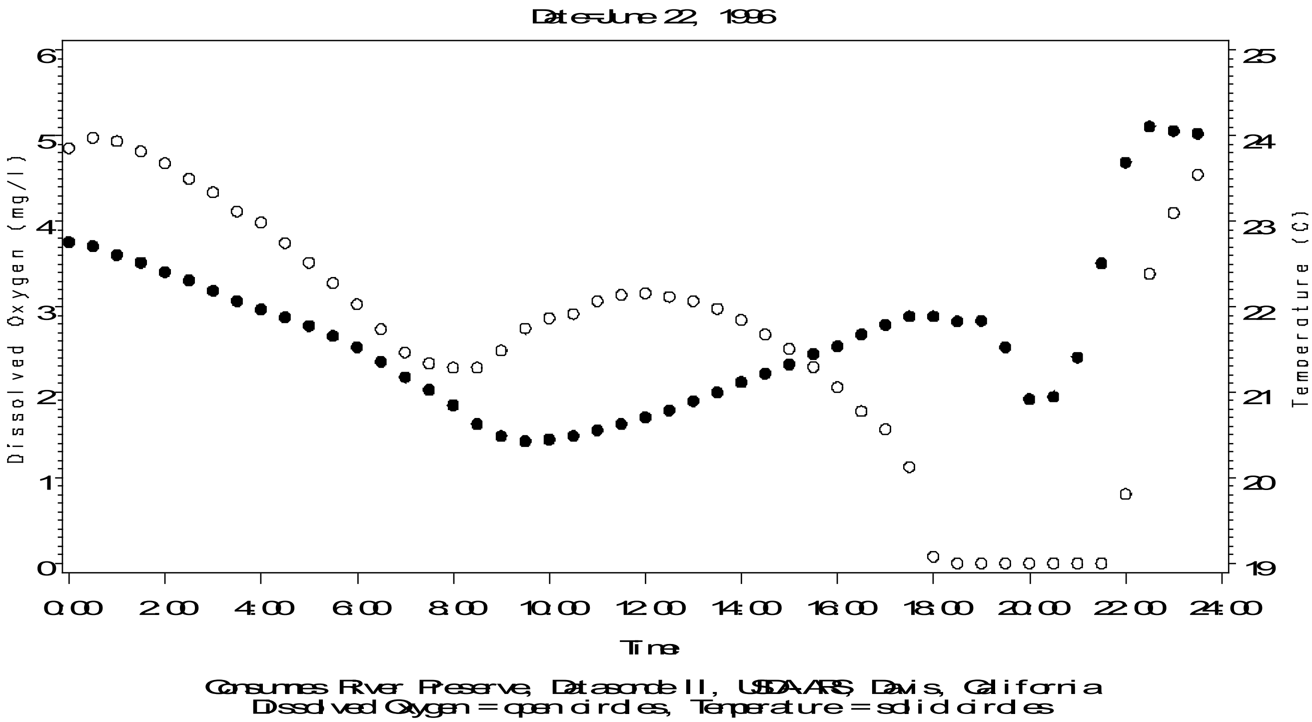
Herbicide	Dissolved Oxygen Requirements	Number of Treatments	Time Between Treatments
2,4-D	It may be appropriate to treat only part of the infestation at one time. For example, apply the product in lanes separated by untreated strips that can be treated after the vegetation in treated lanes has disintegrated (2-3 weeks in growing season). Begin treatment along the shore and move outward in bands to allow fish to move into untreated areas.	Two applications per season	21 days between applications
Glyphosate	When infestations require treatment of the total surface area of impounded water*, treating the area in strips may avoid oxygen depletion due to decaying vegetation.	May require retreatment	24 hours between applications
Penoxsulam	None	Not specified	Not specified
Imazamox	None	Up to 4 applications per season at 32 ounces per acre application rate	Not specified
Imazapyr	When infestations require treatment of the total surface area of impounded water*, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Do not treat more than one-half of the surface area of the water in a single operation. Begin treatment along the shore and move outward in bands to allow fish to move into untreated areas.	Up to 3 applications per season at 32 ounces per acre application rate	10 to 14 days between treatments

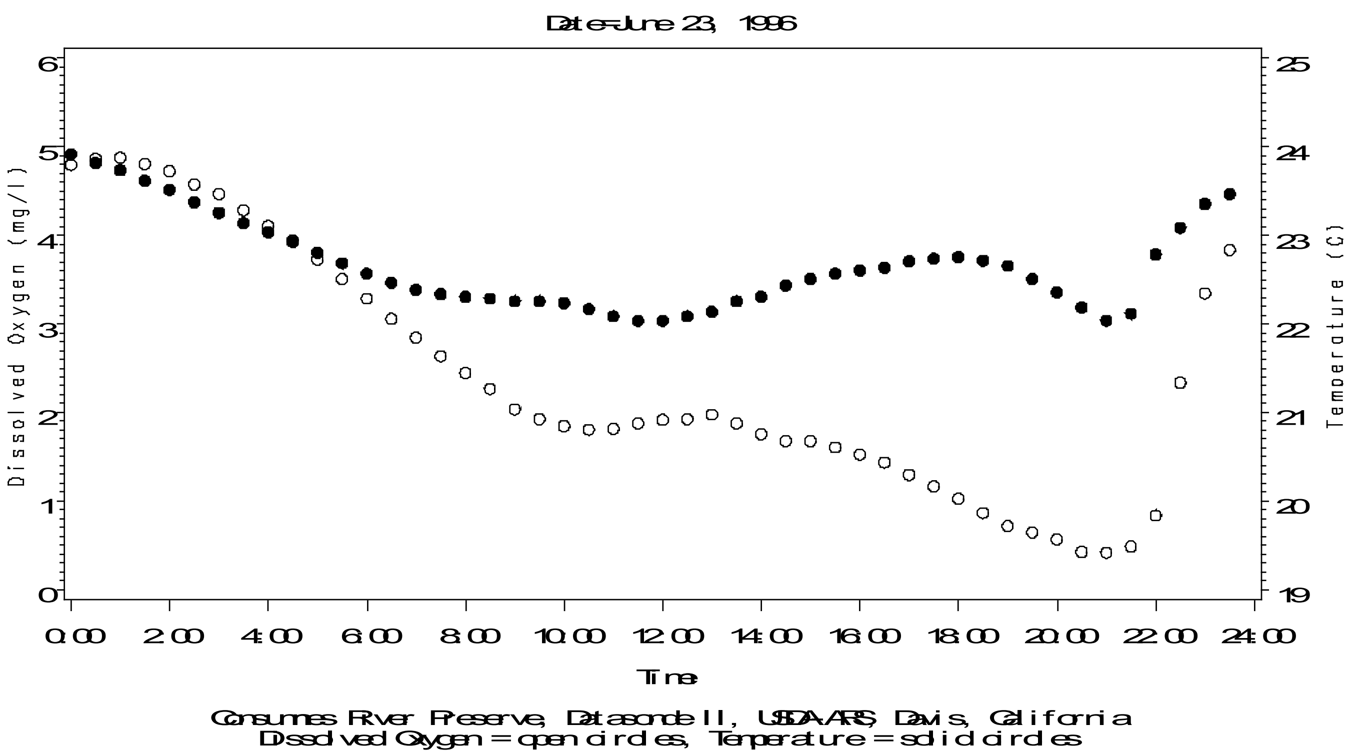
* The WHCP project area encompasses tidal and riverine waters, not impounded waters.

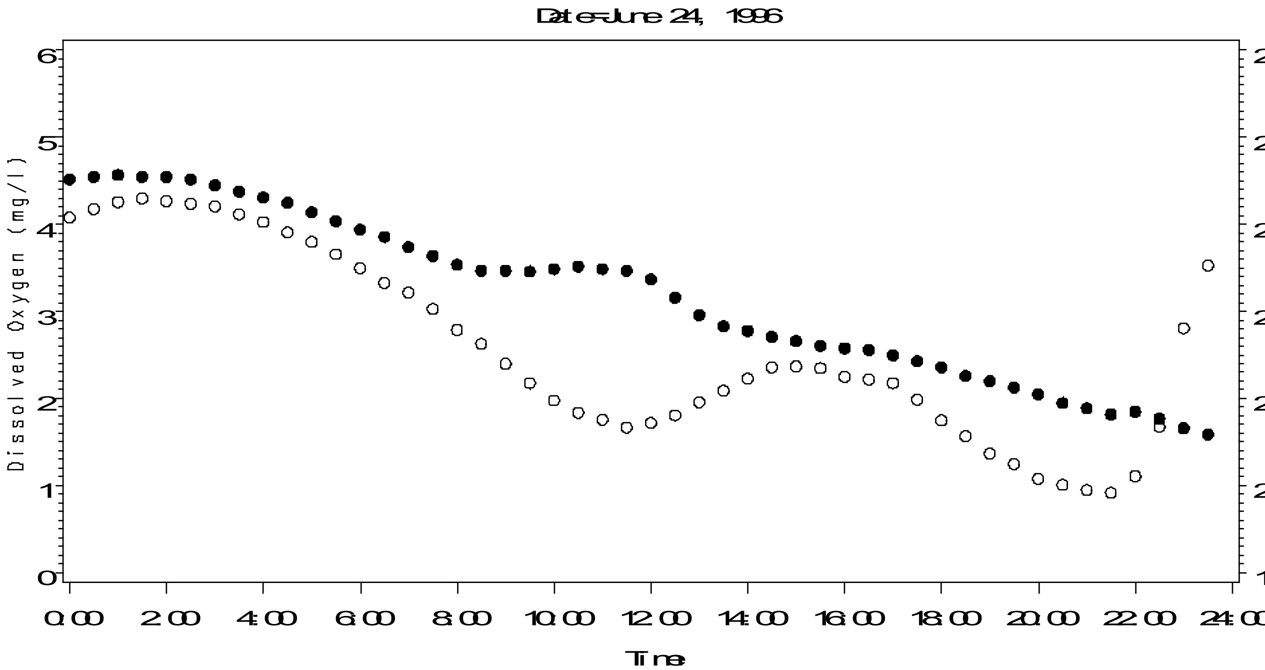
Existing DO levels in large water hyacinth mats are often already low, particularly in slower-moving waters and dead-end sloughs. Thus, with adequate avoidance measures, further decreases in dissolved oxygen that would impede fish passage can be avoided and/or minimized. Large patches of water hyacinth can cause low dissolved oxygen levels (Toft 2000). Data summarized below indicate that DO levels under water hyacinth mats are lower than DO levels elsewhere in the Delta. Toft found average spot DO measurements below 5 mg/l for water hyacinth and above 5 mg/l for pennywort (Toft 2000). In a similar study of DO in aquatic weeds in Texas, water hyacinth was found to have the lowest DO levels as compared to milfoil, hydrilla, pondweed, and a mix of native species, and was the only plant to have DO levels below 5 mg/l (Madsen 1997 in Toft).

Research in the Delta conducted by USDA-ARS measured DO levels every half-hour under a large mat of water hyacinth that completely covered a 15-meter wide slough on the Consumnes River Nature Preserve. The slough was subject to tidal flows. Over a four-day period in June 1996, DO levels each day ranged from 0mg/l to just over 5mg/l. Only about 5 of 200 data points measured under the mat were above 5mg/l, and the vast majority of the data points were between 2 mg/l to 4mg/l (Spencer 2001). The results of the DO testing are shown in **Exhibit 2**. These data indicate that large infestations of water hyacinth across waterways, such as those that have occurred on the Merced and San Joaquin Rivers prior to treatment, are likely to impede the passage of fish.

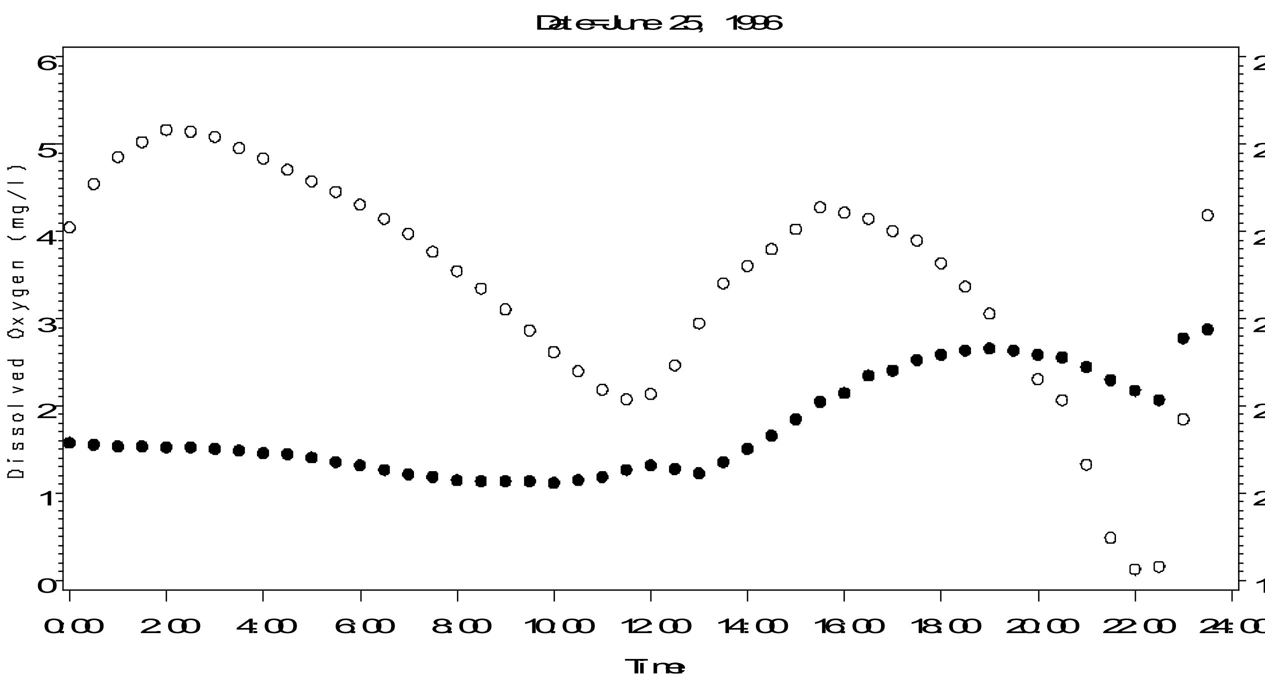
Exhibit 2. Four graphs depicting datasonde results under a dense mat of water hyacinth plants in a slough on the Consumnes River Nature Preserve.







Consumes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles



Consumes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles

Results of WHCP Dissolved Oxygen Monitoring

DBW and USDA-ARS track two sets of DO monitoring. At every herbicide application, treatment crews take DO samples immediately prior to treating, and approximately one-hour post-treatment. These levels would be expected to be similar, as they occur a few hours apart and the potential for lowering DO due to decaying water hyacinth would not occur immediately post-treatment. Data from Daily Treatment Logs support that there is no significant impact on DO immediately post-treatment. Of 719 treatments occurring between 2007 and 2011, there were 13 cases with no change in DO, 404 cases with an increase in DO (average increase of 0.8 mg/l), and 302 cases with an average decrease in DO (average decrease of 0.6 mg/l). The average pre-treatment DO was 7.9 mg/l, and the average post-treatment DO was 8.1 mg/l. The minimum allowable DO in most of the WHCP program area is 5.0 mg/l. Both pre- and post-treatment levels are well above the 5.0 mg/l considered safe for fish.

The DO monitoring that occurs with follow-up water quality sampling would be more likely to show potential decreases in DO, as post-treatment sampling occurs several days after treatment, when plant death symptoms are starting to occur. However, representative DO monitoring data from 2011 shows that herbicide treatments do not significantly impact DO. The data below in **Table 2** provide 2011 treatment and post-treatment DO levels taken at the time of water quality sampling, on the day of treatment, and between four and seven days post-treatment. In five cases, DO levels increased. Note that the most significant increase occurred at Site 16, where existing DO was at an extremely low 2.06 mg/l prior to treatment (a level resulting in stress and avoidance for fish), and DO increased by six days post-treatment to 7.03 mg/l, a level safe for fish. In the other instance of extremely low DO prior to treatment at site 301, DO increased from 1.07 mg/l to 2.71 mg/l by five days post-treatment. In these two critical cases where DO levels prior to treatment were below levels safe for fish, DO levels improved following WHCP treatments. The average decrease in DO among the six 2011 monitoring sites with decreased DO was 0.79 mg/l, and in all cases where DO decreased, it was still well above the Basin Plan minimum of 5.0 mg/l. DBW and USDA-ARS will continue to monitor pre- and post-treatment DO levels.

Table 2
Comparison of Treatment and Post-Treatment Dissolved Oxygen Levels (in mg/l) (2011)

Site	Days Post Treatment	Treatment DO	Post-Treat DO	Difference (Post-Treatment)
2,4-D Treatments				
13	6	7.18	7.09	(0.09)
14	5	8.46	7.23	(1.23)
15	6	7.74	7.73	(0.01)
16*	6	2.06	7.03	4.97
58	6	7.06	7.15	0.09
59	4	6.92	6.98	0.06
68	6	7.86	7.97	0.11
Glyphosate Treatments				
216	7	9.80	8.40	(1.40)
217	7	7.70	6.18	(1.52)
300	5	8.50	8.00	(0.50)
301*	5	1.07	2.71	1.64
Average increase for five increased DO sites:				1.37
Average decrease for six decreased DO sites:				(0.79)

* Highlighted rows had DO levels harmful to fish prior to WHCP treatments.

If reductions in dissolved oxygen do occur, these decreases in DO resulting from treatment of water hyacinth are likely to be short-term since the Delta is a flowing rather than a standing water system. One of the long-term benefits of treating with herbicides is a reduction in the volume of water hyacinth in the Delta. Removing large patches of water hyacinth will allow DO levels to increase, thus enhancing the ability of fish to move unimpeded in Delta waters. It can be argued that such a benefit outweighs the impact of potential short-term localized decreases in dissolved oxygen.

Fish Passage Protocol

There is very little quantitative information and/or scientific literature upon which to base treatment acreage limitations for a fish passage protocol, and even less information specific to the Delta environment. The previous 3 acre limitation was originally put forward by a member of the Water Hyacinth Task Force in the early 1980s as a precautionary limit to address potential for reductions in water quality beneficial uses. At the time the 3 acres was proposed, water hyacinth treatments started earlier in the season, before mats grew to the large acreage (sometimes over 50 acres) that can occur in today's Delta environment. Based on data summarized in this document, these large mats likely have a greater detrimental impact on dissolved oxygen than herbicide treatments.

The protocol below is based on combined recommendations of an aquatic weed expert, an herbicide company representative, the Pacific Northwest Weed Management Handbook, Washington State NPDES requirements, herbicide label requirements, Delta water conditions, prior dissolved oxygen monitoring data, the prior 3 acre limit, and literature on salmonid migration. The intent is to provide a fish passage protocol with numerical treatment limits that provide conservative fish protection, reflect actual Delta conditions, take into account the variability in treatment site size (6.5 acres to 1,707 acres) and consider field operation constraints.

1. In slow-moving and back-end sloughs infested with water hyacinth, DBW will treat up to 30 percent of the water hyacinth mat at one time. Mats will be treated in up to 3 acre strips, leaving at least 100 foot buffer strips between treated areas. The untreated buffer strips and remaining 70 percent of the water hyacinth mat will be treated at least three more times following the initial treatment (in 30 percent increments). These follow-up treatments will take place at three week intervals.

2. In Delta tidal waters, DBW will treat up to 50 percent of the water hyacinth mat at one time. Mats will be treated in up to 3 acre strips, leaving at least 100 foot buffer strips between treated areas. The untreated buffer strips and remaining 50 percent of the mat will be treated three weeks following the initial treatment for 2,4-D treatments, and one week following initial treatment for other herbicides.

3. If DO levels in an area to be treated are at a level considered to be detrimental to fish species prior to treatment (below 3 mg/liter), the DBW may treat the entire area (without the 3 acre strips or buffer strips), therefore allowing the DO levels to increase to beneficial use levels once the water hyacinth is controlled.

4. For each treatment site and herbicide application, DBW staff shall follow herbicide label requirements, as specified, to reduce the potential for low dissolved oxygen. Current requirements for WHCP herbicides are provided in Table 1.

5. When follow-up herbicide applications of previously treated plants are required, DBW staff shall follow herbicide label requirements, as specified, regarding the number of treatments and time between treatments.

Below, and in **Exhibit 3**, starting on page 12, we provide examples of the fish passage protocol. The large numerals in Exhibit 3 refer to the treatment number.

20 acre water hyacinth mat in a dead end slough site:

<u>Treatment 1</u>: 30% = 6 acres

Protocol – spray two strips of 3 acres each with 100 feet between strips

<u>Treatment 2</u>: 30% = 6 acres

Protocol – spray two strips of just under 3 acres each with 100 feet between strips, plus the previously untreated strip

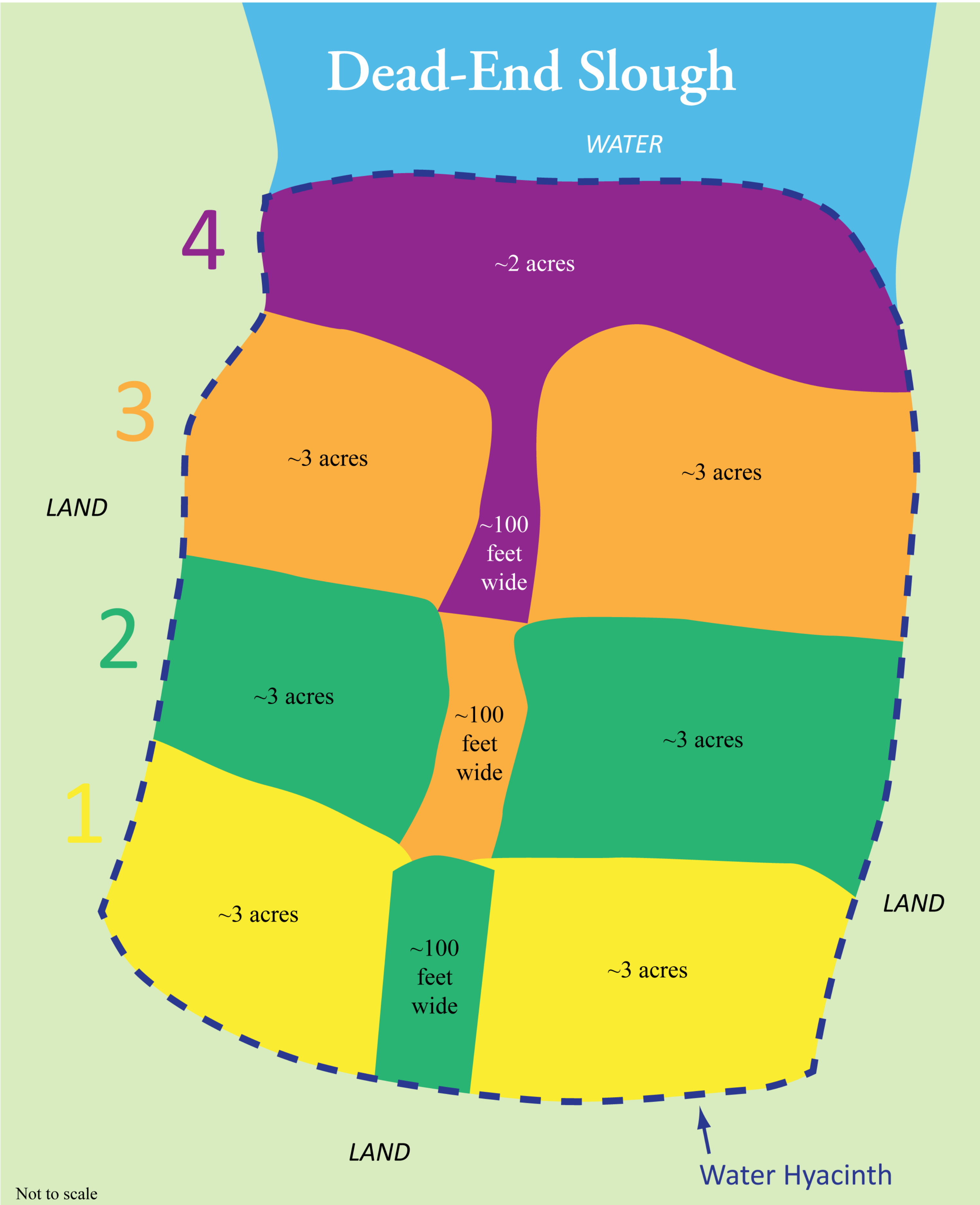
Treatment 3: 30% = 6 acres
Protocol – spray two strips of just under 3 acres each with 100 feet between strips, plus the previously untreated strip
Treatment 4: 10% = 2+ acres
Protocol – spray the remaining 2+ acres, plus the previously untreated strip.

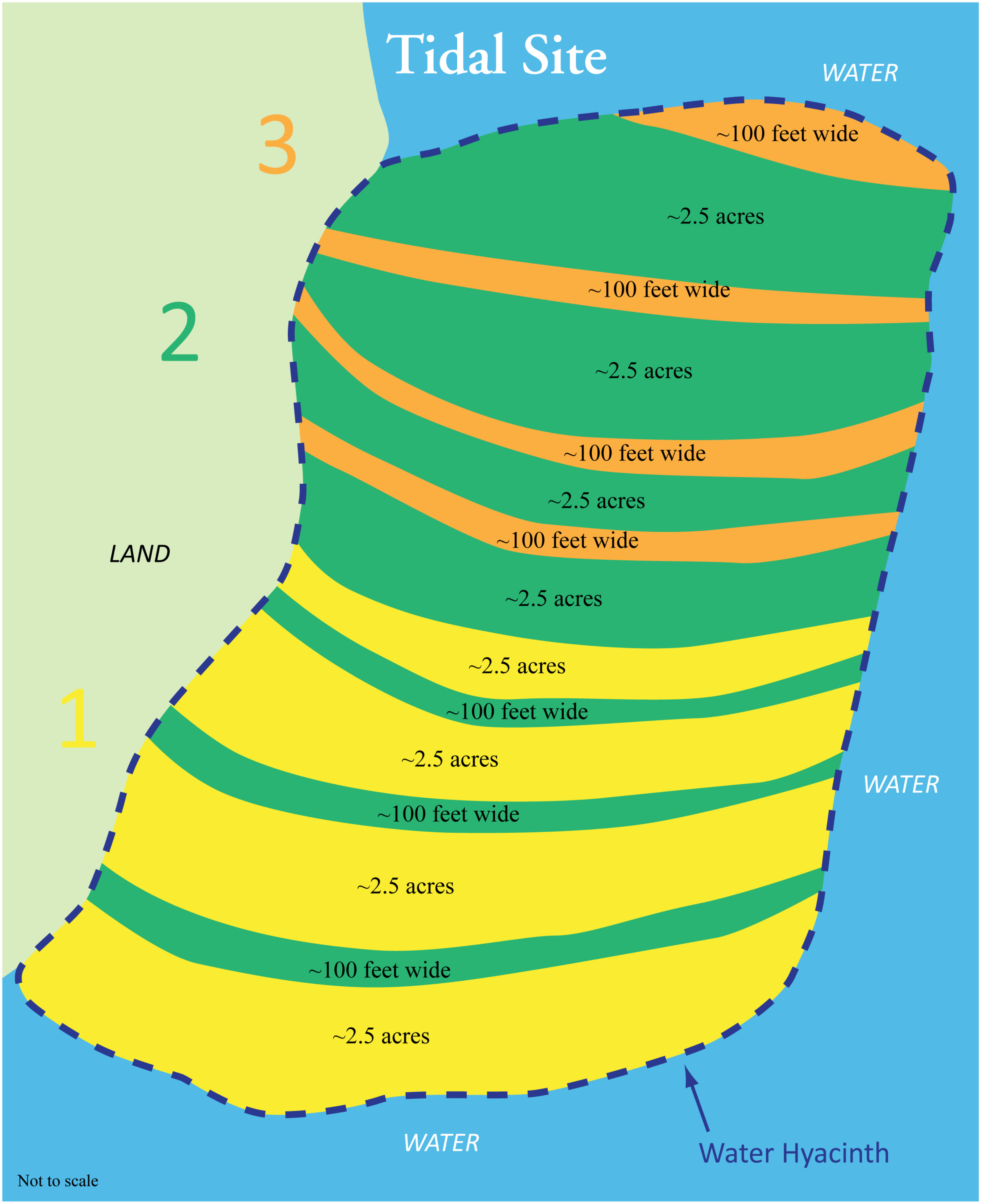
20 acre water hyacinth mat in a tidal site:

Treatment 1: 50% = 10 acres
Protocol – spray three strips of 3 acres plus one strip of 1 acre with 100 feet between strips, or treat four 4 strips of 2.5 acres with 100 feet between strips
Treatment 2: 50% = 10 acres
Protocol – spray three strips of just under 3 acres plus one strip of 1 acre with 100 feet between strips, or treat four 4 strips of just under 2.5 acres with 100 feet between strips, plus previously untreated strips
Treatment 3: untreated strips
Protocol – spray remaining untreated strips from Treatment 2.

Exhibit 3

Example Fish Passage Protocol for 20 Acres of Water Hyacinth




Tidal Site
WATER
3
~100 feet wide
~2.5 acres
2
~100 feet wide
~2.5 acres
~100 feet wide
~2.5 acres
LAND
~100 feet wide
~2.5 acres
~2.5 acres
1
~100 feet wide
~2.5 acres
WATER
~100 feet wide
~2.5 acres
~100 feet wide
~2.5 acres
WATER
Water Hyacinth
Not to scale

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Appendix B

List of WHCP Treatment Sites by USFWS Area

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
1	16	1	3	San Joaquin	Mandeville Cut, Mandeville Reach, San Joaquin River- Stockton Deep Water Channel, Three River Reach, Venice Cut, Venice Reach	Tidal	924.9
2	17a	1	3	Contra Costa	Potato Slough	Tidal	231.1
3	17b	1	3	San Joaquin	Potato Slough	Tidal	611.1
4	18a	1	6	Sacramento	Mokelumne River	Tidal	170.3
5	18b	1	6	San Joaquin	Mokelumne River	Tidal	169.5
6	19a	1	6	Contra Costa	San Joaquin River	Tidal	426.7
7	19b	1	6	San Joaquin	San Joaquin River	Tidal	345.8
8	20	1	6	Sacramento	San Joaquin River, Seven Mile Cut	Tidal	124.7
9	21a	1	6	Sacramento	San Joaquin River	Tidal	606.6
10	21b	1	6	Contra Costa	San Joaquin River	Tidal	627.1
11	22	1	7	Sacramento	Sacramento River, Three Mile Slough	Tidal	734.5
12	23a	1	7	Sacramento	False River, San Joaquin River	Tidal	344.0
13	23b	1	7	Contra Costa	False River, San Joaquin River	Tidal	488.1
14	24a	1	7	Sacramento	San Joaquin River	Tidal	440.6
15	24b	1	7	Contra Costa	San Joaquin River	Tidal	459.0
16	39	1	3	San Joaquin	White Slough	Tidal	211.7
17	40	1	3	San Joaquin	Grindstone	Tidal	120.7
18	41	1	3	San Joaquin	Little Potato Slough	Tidal	135.3
19	42	1	3	San Joaquin	Little Connection Slough	Tidal	99.3
20	43	1	3	San Joaquin	Potato Slough	Tidal	201.1
21	44	1	3	San Joaquin	Potato Slough	Tidal	276.6
22	69	1	2	San Joaquin	Little Connection Slough, Middle River	Tidal	300.5
23	98a	1	4	San Joaquin	Old River	Tidal	98.0
24	98b	1	4	Contra Costa	Old River	Tidal	136.5
25	99a	1	4	Contra Costa	Old River	Tidal	206.1
26	99b	1	4	San Joaquin	Old River	Tidal	260.8
27	100	1	4	San Joaquin	Connection Slough, Old River	Tidal	299.6
28	101a	1	4	Contra Costa	Old River, Mandeville Island	Tidal	134.3
29	101b	1	4	San Joaquin	Old River, Mandeville Island	Tidal	309.6
30	102	1	4	Contra Costa	Sheep Slough	Tidal	132.0
31	103a	1	4	Contra Costa	Old River	Tidal	132.7
32	103b	1	4	San Joaquin	Old River	Tidal	175.5
33	104a	1	4	Contra Costa	Old River	Tidal	113.2
34	104b	1	4	San Joaquin	Old River	Tidal	97.1
35	105	1	4	Contra Costa	False River	Tidal	450.5
36	106	1	4	Contra Costa	Fishermen's Cut	Tidal	105.2
37	107	1	7	Contra Costa	Piper Slough	Tidal	193.4
38	108	1	7	Contra Costa	Roosevelt Cut, Sand Mound Slough	Tidal	165.9
39	109	1	7	Contra Costa	Sand Mound Slough	Tidal	275.2
40	110	1	7	Contra Costa	Taylor Slough	Tidal	96.1
41	111	1	7	Contra Costa	Taylor Slough	Tidal	78.9
42	112	1	7	Contra Costa	Dutch Slough, Emerson Slough	Tidal	179.4
43	113	1	7	Contra Costa	Dutch Slough	Tidal	95.3
44	114	1	7	Contra Costa	Dutch Slough	Tidal	67.1
45	115	1	7	Contra Costa	Big Break	Tidal	728.9
46	116	1	7	Contra Costa	Big Break	Tidal	210.4
47	117	1	7	Contra Costa	Big Break Marina	Tidal	537.5
48	118	1	7	Contra Costa	Big Break Wetlands	Tidal	79.0
49	119a	1	7	Sacramento	San Joaquin River	Tidal	348.8
50	119b	1	7	Contra Costa	San Joaquin River	Tidal	506.8
51	120a	1	7	Sacramento	San Joaquin River	Tidal	756.9
52	120b	1	7	Contra Costa	San Joaquin River	Tidal	474.6
53	121a	1	7	Sacramento	San Joaquin River	Tidal	259.5
54	121b	1	7	Contra Costa	San Joaquin River	Tidal	496.4
55	122	1	7	Sacramento	Sherman Lake	Tidal	206.2
56	123	1	7	Sacramento	Sherman Lake	Tidal	155.4
57	124	1	7	Sacramento	Sherman Lake	Tidal	96.5
58	125	1	7	Sacramento	Sherman Lake	Tidal	1,005.6
59	126	1	7	Sacramento	Sherman Lake	Tidal	187.6
60	127	1	7	Sacramento	Sherman Lake	Tidal	85.4
61	128	1	7	Sacramento	Sherman Lake	Tidal	87.1
62	129	1	7	Sacramento	Sherman Lake	Tidal	554.8
63	130	1	7	Sacramento	Sherman Lake	Tidal	31.9
64	131	1	7	Sacramento	Sherman Lake	Tidal	952.0
65	132	1	7	Sacramento	Sherman Lake	Tidal	178.3

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
66	133	1	7	Contra Costa	Sherman Lake	Tidal	1,141.0
67	134	1	7	Contra Costa	San Joaquin River	Tidal	627.2
68	135	1	7	Sacramento	Sacramento River	Tidal	489.9
69	136	1	7	Solano	Sacramento River	Tidal	386.8
70	137	1	7	Solano	Sacramento River	Tidal	193.5
71	138	1	7	Solano	Sacramento River	Tidal	485.2
72	139	1	7	Solano	Sacramento River	Tidal	805.6
73	140	1	6	Solano	Rio Vista/Sandy Beach	Tidal	534.7
74	141	1	6	Sacramento	Duck Island RV	Tidal	510.5
75	173	1	4	Contra Costa	Franks Tract West	Tidal	1,322.3
76	174	1	4	Contra Costa	Franks Tract Middle	Tidal	1,707.1
77	175	1	4	Contra Costa	Franks Tract East	Tidal	436.7
78	176	1	7	Solano	Sacramento River-Decker Island	Tidal	415.3
79	200	1	5	San Joaquin	South Mokelumne River	Tidal	159.7
80	201	1	5	San Joaquin	South Mokelumne River	Tidal	199.7
81	202	1	5	San Joaquin	South Mokelumne River	Tidal	204.0
82	203	1	5	San Joaquin	Sycamore Slough	Tidal	248.0
83	204	1	5	San Joaquin	South Mokelumne River	Tidal	114.9
84	205	1	5	San Joaquin	Hog Slough	Tidal	114.8
85	206	1	5	San Joaquin	South Mokelumne River	Tidal	85.4
86	207	1	5	San Joaquin	Beaver Slough	Tidal	78.0
87	208	1	5	San Joaquin	South Mokelumne River	Tidal	67.8
88	209a	1	5	Sacramento	North Mokelumne River	Tidal	120.2
89	209b	1	5	San Joaquin	North Mokelumne River	Tidal	123.3
90	210a	1	5	Sacramento	North Mokelumne River	Tidal	52.9
91	210b	1	5	San Joaquin	North Mokelumne River	Tidal	51.1
92	211a	1	5	Sacramento	North Mokelumne River	Tidal	54.4
93	211b	1	5	San Joaquin	North Mokelumne River	Tidal	55.6
94	212a	1	5	Sacramento	North Mokelumne River	Tidal	164.3
95	212b	1	5	San Joaquin	North Mokelumne River	Tidal	7.1
96	213a	1	5	Sacramento	North Mokelumne River	Tidal	76.5
97	213b	1	5	San Joaquin	North Mokelumne River	Tidal	49.8
98	214	1	5	Sacramento	Snodgrass Slough	Tidal	110.0
99	215	1	5	Sacramento	Lost Slough	Tidal	199.1
100	216	1	5	Sacramento	Snodgrass Slough	Tidal	89.1
101	217	1	5	Sacramento	Snodgrass Slough	Tidal	156.3
102	218	1	5	Sacramento	Snodgrass Slough	Tidal	26.3
103	219	1	5	Sacramento	Snodgrass Slough	Tidal	21.7
104	220	1	0	Sacramento	Stone Lakes	Tidal	98.8
105	221	1	0	Sacramento	Stone Lakes	Tidal	16.1
106	222	1	0	Sacramento	Stone Lakes	Tidal	87.1
107	223	1	0	Sacramento	Stone Lakes	Tidal	48.9
108	224	1	0	Sacramento	Stone Lakes	Tidal	67.8
109	225	1	0	Sacramento	Stone Lakes	Tidal	40.8
110	226	1	0	Sacramento	Stone Lakes	Tidal	38.6
111	230	1	0	Sacramento	Stone Lakes	Tidal	20.9
112	231	1	0	Sacramento	Stone Lakes	Tidal	28.2
113	232	1	0	Sacramento	Stone Lakes	Tidal	115.3
114	233	1	0	Sacramento	Stone Lakes	Tidal	73.5
115	234	1	0	Sacramento	Stone Lakes	Tidal	49.9
116	235	1	0	Sacramento	Stone Lakes	Tidal	52.1
117	236	1	0	Sacramento	Stone Lakes	Tidal	6.9
118	237	1	0	Sacramento	Stone Lakes	Tidal	102.6
119	238	1	0	Sacramento	Stone Lakes	Tidal	79.9
120	239	1	0	Sacramento	Stone Lakes	Tidal	10.3
121	240a	1	6	Sacramento	Brannon Island	Tidal	113.1
122	240b	1	6	Sacramento	Rio vista	Tidal	219.8
123	241	1	6	Sacramento	Sacramento River	Tidal	195.9
124	242	1	6	Sacramento	Sacramento River	Tidal	136.1
125	243	1	6	Sacramento	Sacramento River	Tidal	145.9
126	244	1	6	Sacramento	Sacramento River	Tidal	162.3
127	245	1	6	Sacramento	Sacramento River	Tidal	194.3
128	246a	1	6	Yolo ?	Sacramento River	Tidal	90.0
129	246b	1	6	Sacramento	Sacramento River	Tidal	212.1
130	247a	1	6	Yolo ?	Sacramento River	Tidal	140.2
131	247b	1	6	Sacramento	Sacramento River	Tidal	138.8
132	248a	1	6	Yolo	Sacramento River	Tidal	109.8

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
133	248b	1	6	Sacramento	Sacramento River	Tidal	102.9
134	249a	1	6	Yolo ?	Sacramento River	Tidal	100.7
135	249b	1	6	Sacramento	Sacramento River	Tidal	103.7
136	250a	1	0	Yolo	Sacramento River	Tidal	362.0
137	250b	1	0	Sacramento	Sacramento River	Tidal	353.1
138	251a	1	6	Solano	Sacramento River, Viera's	Tidal	83.1
139	251b	1	6	Sacramento	Sacramento River, Viera's	Tidal	102.2
140	252a	1	6	Solano	Sacramento River, Snug Harbor	Tidal	98.3
141	252b	1	6	Sacramento	Sacramento River, Snug Harbor	Tidal	93.1
142	253a	1	6	Solano	Ryer Island	Tidal	41.9
143	253b	1	6	Sacramento	Ryer Island	Tidal	41.1
144	254	1	6	Sacramento	Sutter Island	Tidal	75.8
145	255	1	6	Sacramento	Sutter Island	Tidal	48.9
146	256a	1	6	Solano	Sutter Island	Tidal	20.2
147	256b	1	6	Sacramento	Sutter Island	Tidal	19.2
148	257a	1	6	Solano	Sutter Island	Tidal	29.2
149	257b	1	6	Sacramento	Sutter Island	Tidal	27.5
150	258a	1	6	Yolo	Sutter Island	Tidal	18.9
151	258b	1	6	Sacramento	Sutter Island	Tidal	18.3
152	259	1	0	Sacramento	Merritt Island	Tidal	165.4
153	260	1	6	Solano	Ryer Island	Tidal	250.4
154	261	1	6	Solano	Ryer Island	Tidal	250.2
155	262	1	6	Solano	Cache Slough	Tidal	308.2
156	263	1	6	Solano	Cache Slough	Tidal	42.0
157	264	1	6	Solano	Cache Slough	Tidal	30.3
158	265	1	6	Solano	Ryer Island	Tidal	60.5
159	266	1	6	Solano	Ryer Island	Tidal	37.0
160	267	1	6	Solano	Liberty Island	Tidal	1,429.8
161	268	1	6	Solano	Sacramento Deep Water Channel	Tidal	292.7
162	269	1	0	Yolo	Sacramento Deep Water Channel	Tidal	1,330.9
163	270	1	6	Solano	Liberty Island	Tidal	1,722.4
164	271	1	6	Solano	Liberty Island	Tidal	442.3
165	272	1	6	Solano	Lindsay Slough	Tidal	326.2
166	273	1	6	Solano	Liberty Island	Tidal	1,102.4
167	274	1	6	Solano	Cache Slough	Tidal	90.9
168	275	1	6	Solano	Cache Slough	Tidal	230.0
169	276	1	6	Yolo	Cache Slough	Tidal	67.4
170	277	1	6	Solano	Lindsay Slough	Tidal	399.5
171	278	1	6	Solano	Hasting Tract	Tidal	122.3
172	279	1	6	Solano	Hasting Tract	Tidal	75.6
173	280	1	6	Solano	Hasting Tract	Tidal	87.9
174	281	1	6	Solano	Egbert Tract	Tidal	133.4
175	282	1	6	Solano	Egbert Tract	Tidal	106.1
176	283	1	6	Solano	Egbert Tract	Tidal	80.3
177	284	1	6	Solano	Egbert Tract	Tidal	92.4
178	285	1	5	San Joaquin	Tyler Island	Tidal	57.3
179	286	1	5	San Joaquin	Tyler Island	Tidal	77.7
180	287	1	5	San Joaquin	Tyler Island	Tidal	55.4
181	288	1	5	San Joaquin	Tyler Island	Tidal	54.7
182	289	1	5	San Joaquin	Tyler Island	Tidal	68.7
183	290a	1	0	Yolo	Deep Water Channel/Port of Sacramento	Tidal	851.1
184	290b	1	0	Sacramento	Sacramento River	Tidal	71.3
185	11	2	2	San Joaquin	Black Slough, Black Slough Landing, Fourteen Mile Slough, San Joaquin River	Tidal	216.9
186	12	2	2	San Joaquin	Turner Cut	Tidal	131.6
187	13	2	2	San Joaquin	Heypress Reach, Hog Island Cut, San Joaquin River- Stockton Deep Water Channel, Twentyone Mile Cut	Tidal	445.9
188	14	2	2	San Joaquin	San Joaquin River	Tidal	416.6
189	15	2	2	San Joaquin	Empire Tract Slough	Tidal	612.9
190	33	2	3	San Joaquin	Disappointment Slough	Tidal	135.4
191	49	2	1	San Joaquin	Middle River - MR	Tidal	81.8
192	50	2	1	San Joaquin	North Canal, Victoria Canal	Tidal	137.5
193	51	2	1	San Joaquin	North Canal, Victoria Canal	Tidal	81.8
194	52	2	1	San Joaquin	Middle River	Tidal	104.0
195	53	2	1	San Joaquin	Middle River	Tidal	126.1
196	54	2	1	San Joaquin	North Victoria Canal, Woodard Canal	Tidal	64.9
197	55	2	1	San Joaquin	North Victoria Canal, Woodard Canal	Tidal	48.8

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
198	56	2	1	San Joaquin	Middle River	Tidal	180.4
199	57	2	4	San Joaquin	Railroad Cut	Tidal	87.2
200	58	2	2	San Joaquin	Middle River	Tidal	159.4
201	59	2	2	San Joaquin	Middle River	Tidal	199.6
202	60	2	2	San Joaquin	Empire Cut	Tidal	271.0
203	61	2	2	San Joaquin	Whiskey Slough	Tidal	78.7
204	62	2	2	San Joaquin	Whiskey Slough	Tidal	71.1
205	63	2	1	San Joaquin	Trapper Slough	Tidal	31.6
206	64	2	1	San Joaquin	Trapper Slough	Tidal	120.9
207	65	2	2	San Joaquin	Latham Slough	Tidal	562.0
208	66	2	2	San Joaquin	Middle River	Tidal	213.2
209	67	2	2	San Joaquin	Middle River	Tidal	472.7
210	68	2	2	San Joaquin	Middle River	Tidal	276.6
211	78	2	1	San Joaquin	Old River - ORT	Tidal	62.6
212	79	2	1	San Joaquin	Old River	Tidal	46.4
213	83a	2	1	Contra Costa	Old River, Widdow Lake	Tidal	25.3
214	83b	2	1	San Joaquin	Old River, Widdow Lake	Tidal	18.6
215	84a	2	1	Contra Costa	Old River	Tidal	60.7
216	84b	2	1	San Joaquin	Old River	Tidal	29.3
217	85a	2	1	Contra Costa	Old River	Tidal	36.3
218	85b	2	1	San Joaquin	Old River	Tidal	89.5
219	86a	2	1	Contra Costa	Old River, West Canal, Coney Island	Tidal	13.0
220	86b	2	1	San Joaquin	Old River, West Canal, Coney Island	Tidal	1,038.1
221	87a	2	1	Contra Costa	Old River	Tidal	58.7
222	87b	2	1	San Joaquin	Old River	Tidal	90.7
223	88	2	1	Contra Costa	Italian Slough	Tidal	1,425.5
224	89a	2	1	Contra Costa	Old River	Tidal	55.9
225	89b	2	1	San Joaquin	Old River	Tidal	42.2
226	90a	2	1	Contra Costa	Old River	Tidal	45.3
227	90b	2	1	San Joaquin	Old River	Tidal	50.6
228	91a	2	1	Contra Costa	Old River	Tidal	113.9
229	91b	2	1	San Joaquin	Old River	Tidal	78.3
230	92a	2	4	Contra Costa	Old River	Tidal	110.3
231	92b	2	4	San Joaquin	Old River	Tidal	143.7
232	93	2	1	Contra Costa	Indian Slough	Tidal	687.4
233	94	2	1	Contra Costa	Warner Dredger Cut/Orwood Resort	Tidal	49.0
234	95	2	4	Contra Costa	Warner Dredger Cut	Tidal	58.0
235	96	2	4	Contra Costa	Warner Dredger Cut	Tidal	59.2
236	97	2	4	Contra Costa	Rock Slough	Tidal	117.8
237	1	3	8	San Joaquin	San Joaquin River	Tidal	113.4
238	2	3	8	San Joaquin	San Joaquin River	Tidal	90.8
239	3	3	8	San Joaquin	San Joaquin River	Tidal	64.6
240	4	3	8	San Joaquin	San Joaquin River	Tidal	60.8
241	5	3	8	San Joaquin	San Joaquin River	Tidal	42.4
242	6	3	8	San Joaquin	French Camp Slough, Walker Slough	Tidal	53.3
243	7	3	3	San Joaquin	San Joaquin River	Tidal	98.0
244	8	3	3	San Joaquin	Mormon Slough, San Joaquin River- Stockton Deep Water Channel	Tidal	492.0
245	9	3	2	San Joaquin	Burns Cutoff	Tidal	61.9
246	10	3	2	San Joaquin	Buckley Cove, San Joaquin River- Stockton Deep Water Channel	Tidal	229.2
247	25	3	3	San Joaquin	Fourteen Mile Slough	Tidal	6.5
248	26	3	3	San Joaquin	Fourteen Mile Slough	Tidal	148.3
249	28	3	3	San Joaquin	Fourteen Mile Slough	Tidal	154.8
250	29	3	3	San Joaquin	Fourteen Mile Slough	Tidal	115.8
251	30	3	3	San Joaquin	Mosher Slough	Tidal	37.7
252	31	3	3	San Joaquin	Bear Creek, Disappointment Slough, Pixley Slough	Tidal	79.7
253	32	3	3	San Joaquin	Disappointment Slough	Tidal	333.1
254	34	3	3	San Joaquin	Bishop Cut	Tidal	112.1
255	35	3	3	San Joaquin	Telephone Cut	Tidal	38.3
256	36	3	3	San Joaquin	White Slough	Tidal	45.0
257	37	3	3	San Joaquin	White Slough	Tidal	197.8
258	38	3	3	San Joaquin	Honker Cut	Tidal	47.9
259	45	3	1	San Joaquin	Middle River	Tidal	10.0
260	46	3	1	San Joaquin	Middle River	Tidal	35.6
261	47	3	1	San Joaquin	Middle River	Tidal	48.0
262	48	3	1	San Joaquin	Middle River - MR	Tidal	43.5
263	70	3	1	San Joaquin	Old River - Head of old River HOR	Tidal	58.7
264	71	3	1	San Joaquin	Old River	Tidal	49.1
265	72	3	1	San Joaquin	Old River, Paradise Cut	Tidal	127.5

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
266	73	3	1	San Joaquin	Old River, Paradise Cut, Salmon Slough - GLC	Tidal	89.2
267	74	3	1	San Joaquin	Sugar Cut, Tom Paine Slough	Tidal	111.6
268	75	3	1	San Joaquin	Old River	Tidal	67.7
269	76	3	1	San Joaquin	Old River	Tidal	82.3
270	77	3	1	San Joaquin	Old River - ORT	Tidal	103.1
271	80	3	1	San Joaquin	Fabian & Bell Canal, Grant Line Canal	Tidal	176.0
272	81	3	1	San Joaquin	Fabian & Bell Canal, Grant Line Canal - GLC	Tidal	106.0
273	82	3	1	San Joaquin	Fabian & Bell Canal, Grant Line Canal - GLC	Tidal	62.2
274	291	3	1	San Joaquin		Tidal	112.1
275	300	4	8	San Joaquin	San Joaquin River	Riverine	193.5
276	301	4	8	San Joaquin	Welthall Slough	Riverine	66.9
277	302	4	8	San Joaquin	San Joaquin River	Riverine	72.4
278	303	4	8	San Joaquin	San Joaquin River	Riverine	120.1
279	304	4	8	San Joaquin	San Joaquin River	Riverine	127.0
280	305	4	8	San Joaquin	San Joaquin River	Riverine	104.7
281	306	4	8	San Joaquin	San Joaquin River	Riverine	101.5
282	307	4	8	San Joaquin	San Joaquin River	Riverine	199.7
283	308	4	8	San Joaquin	San Joaquin River	Riverine	133.4
284	309	4	8	San Joaquin	San Joaquin River	Riverine	132.7
285	310	4	8	Stanislaus	San Joaquin River	Riverine	63.8
286	311	4	8	Stanislaus	Finnegan Cut, San Joaquin River	Riverine	91.9
287	312	4	8	Stanislaus	Finnegan Cut, San Joaquin River	Riverine	71.2
288	313	4	8	Stanislaus	San Joaquin River	Riverine	80.2
289	315	4	8	Stanislaus	Laird Slough	Riverine	33.9
290	316	4	8	Stanislaus	Brush Lake	Riverine	54.3
291	317	4	8	Stanislaus	Del Puerto Creek, San Joaquin River	Riverine	27.4
292	318	4	8	Stanislaus	San Joaquin River	Riverine	51.8
293	319	4	8	Stanislaus	San Joaquin River	Riverine	38.7
294	320	4	8	Stanislaus	San Joaquin River, Lake Ramona	Riverine	60.5
295	321	4	8	Stanislaus	San Joaquin River	Riverine	56.7
296	322	4	8	Stanislaus	San Joaquin River	Riverine	45.2
297	323	4	8	Stanislaus	San Joaquin River	Riverine	84.4
298	324	4	8	Merced, Stanislaus	San Joaquin River	Riverine	73.3
299	325	4	8	Merced, Stanislaus	San Joaquin River	Riverine	54.4
300	400	4	8	Merced	San Joaquin River	Riverine	16.4
301	401	4	8	Merced	San Joaquin River	Riverine	32.9
302	402	4	8	Merced	Snag Slough, San Joaquin River	Riverine	43.8
303	403	4	8	Merced	San Joaquin River	Riverine	96.8
304	404	4	8	Merced	San Joaquin River	Riverine	51.5
305	405	4	8	Merced	Salt Slough	Riverine	24.8
306	406	4	8	Merced	Salt Slough	Riverine	8.3
307	407	4	8	Merced	Salt Slough	Riverine	24.0
308	408	4	8	Merced	Salt Slough	Riverine	36.2
309	409	4	8	Merced	Salt Slough	Riverine	37.8
310	410	4	8	Merced	Salt Slough	Riverine	19.3
311	411	4	8	Merced	Mud Slough	Riverine	19.3
312	412	4	8	Merced	Salt Slough	Riverine	10.4
313	413	4	8	Merced	Salt Slough	Riverine	17.7
314	414	4	8	Merced	San Joaquin River, Poso Slough, Salt Slough	Riverine	68.6
315	415	4	8	Merced	San Joaquin River	Riverine	57.5
316	416	4	8	Merced	Bear Creek, Bravel Slough	Riverine	33.0
317	417	4	8	Merced	San Joaquin River	Riverine	26.6
318	418	4	8	Merced	San Joaquin River	Riverine	22.2
319	419	4	8	Merced	San Joaquin River	Riverine	60.1
320	420	4	8	Merced	San Joaquin River	Riverine	46.4
321	421	4	8	Merced	San Joaquin River	Riverine	30.1
322	422	4	8	Merced	San Joaquin River	Riverine	49.7
323	425	4	8	Merced	San Joaquin River	Riverine	22.7
324	426	4	8	Merced	San Joaquin River	Riverine	32.3
325	427	4	8	Merced	San Joaquin River	Riverine	28.8
326	500	4	8	Merced	Merced River	Riverine	16.1
327	501	4	8	Merced	Merced River	Riverine	20.4
328	502	4	8	Merced	Merced River	Riverine	17.8
329	503	4	8	Merced	Merced River	Riverine	28.9
330	504	4	8	Merced	Merced River	Riverine	21.2
331	505	4	8	Merced	Merced River	Riverine	11.2
332	506	4	8	Merced	Merced River	Riverine	20.2
333	507	4	8	Merced	Merced River	Riverine	20.6
334	508	4	8	Merced	Merced River	Riverine	25.5
335	509	4	8	Merced	Merced River	Riverine	11.7
336	510	4	8	Merced	Merced River	Riverine	29.5

Appendix B - List of WHCP Treatment Sites by USFWS Area

Count	Site Number	USFWS Area	DBW Area	County	Location	Water-Type	Water Acres
337	511	4	8	Merced	Merced River	Riverine	59.3
338	512	4	8	Merced	Merced River	Riverine	68.4
339	513	4	8	Merced	Merced River	Riverine	29.4
340	514	4	8	Merced	Merced River	Riverine	20.3
341	515	4	8	Merced	Merced River	Riverine	18.5
342	517	4	8	Merced	Merced River	Riverine	19.7
343	518	4	8	Merced	Merced River	Riverine	24.8
344	519	4	8	Merced	Merced River	Riverine	23.9
345	520	4	8	Merced	Merced River	Riverine	42.2
346	521	4	8	Merced	Merced River	Riverine	49.6
347	522	4	8	Merced	Merced River	Riverine	20.8
348	523	4	8	Merced	Merced River	Riverine	21.4
349	524	4	8	Merced	Merced River	Riverine	5.3
350	526	4	8	Merced	Merced River	Riverine	13.1
351	527	4	8	Merced	Merced River	Riverine	33.3
352	528	4	8	Merced	Merced River, North Canal	Riverine	93.2
353	529	4	8	Merced	Merced River, North Canal	Riverine	3.1
354	530	4	8	Merced	Merced River	Riverine	1.4
355	531	4	8	Merced	Main Canal	Riverine	7.0
356	532	4	8	Merced	Merced River	Riverine	67.5
357	600	4	8	Stanislaus	Stanislaus River	Riverine	36.0
358	700	4	8	Stanislaus	Tuolumne River	Riverine	43.8
359	701	4	8	Stanislaus	Tuolumne River	Riverine	40.1
360	702	4	8	Stanislaus	Tuolumne River	Riverine	19.9
361	703	4	8	Stanislaus	Tuolumne River	Riverine	56.5
362	704	4	8	Stanislaus	Tuolumne River	Riverine	48.7
363	705	4	8	Stanislaus	Tuolumne River (Spillway)	Riverine	47.5
364	706	4	8	Stanislaus	Tuolumne River	Riverine	53.9
365	707	4	8	Stanislaus	Tuolumne River	Riverine	39.1
366	708	4	8	Stanislaus	Tuolumne River	Riverine	70.9
367	709	4	8	Stanislaus	Tuolumne River Fox Grove	Riverine	72.6
368	710	4	8	Stanislaus	Tuolumne River	Riverine	59.2
369	711	4	8	Stanislaus	Tuolumne River	Riverine	48.2
370	712	4	8	Stanislaus	Tuolumne River	Riverine	46.9
371	713	4	8	Stanislaus	Tuolumne River	Riverine	39.9
372	714	4	8	Stanislaus	Tuolumne River	Riverine	42.1
373	715	4	8	Stanislaus	Tuolumne River	Riverine	44.5
374	716	4	8	Stanislaus	Tuolumne River	Riverine	40.9
375	717	4	8	Stanislaus	Tuolumne River	Riverine	38.1
376	718	4	8	Stanislaus	Tuolumne River	Riverine	74.3
377	900	4	8	Fresno	San Joaquin River	Riverine	25.7
378	901	4	8	Fresno	San Joaquin River	Riverine	39.4
379	902	4	8	Fresno	San Joaquin River	Riverine	36.7
380	903	4	8	Fresno	San Joaquin River	Riverine	35.3
381	904	4	8	Fresno	San Joaquin River	Riverine	34.5
382	905	4	8	Fresno	San Joaquin River	Riverine	54.4
383	909	4	8	Fresno	San Joaquin River	Riverine	28.6
384	910	4	8	Fresno	San Joaquin River, Mendota Pool	Riverine	817.3
385	910A	4	8	Fresno	Fresno Slough, Kings River	Riverine	167.2
386	910B	4	8	Fresno	Fresno Slough, Kings River	Riverine	98.2
387	911	4	8	Fresno	San Joaquin River	Riverine	10.1
388	915	4	8	Fresno	San Joaquin River	Riverine	0.4
389	916	4	8	Fresno	San Joaquin River	Riverine	23.7
390	917	4	8	Fresno	San Joaquin River	Riverine	25.3
391	918	4	8	Fresno	San Joaquin River	Riverine	64.8
392	919	4	8	Fresno	San Joaquin River	Riverine	17.5
393	920	4	8	Fresno	San Joaquin River	Riverine	38.1
394	921	4	8	Fresno	San Joaquin River	Riverine	55.4
395	922	4	8	Fresno	San Joaquin River	Riverine	39.5
396	923	4	8	Fresno	San Joaquin River	Riverine	103.9
397	924	4	8	Fresno	San Joaquin River	Riverine	196.6
398	925	4	8	Fresno	San Joaquin River	Riverine	207.8
399	926	4	8	Fresno	San Joaquin River	Riverine	72.6
400	927	4	8	Fresno	San Joaquin River	Riverine	55.1
401	928	4	8	Fresno	San Joaquin River	Riverine	91.3
402	929	4	8	Fresno	San Joaquin River	Riverine	32.9